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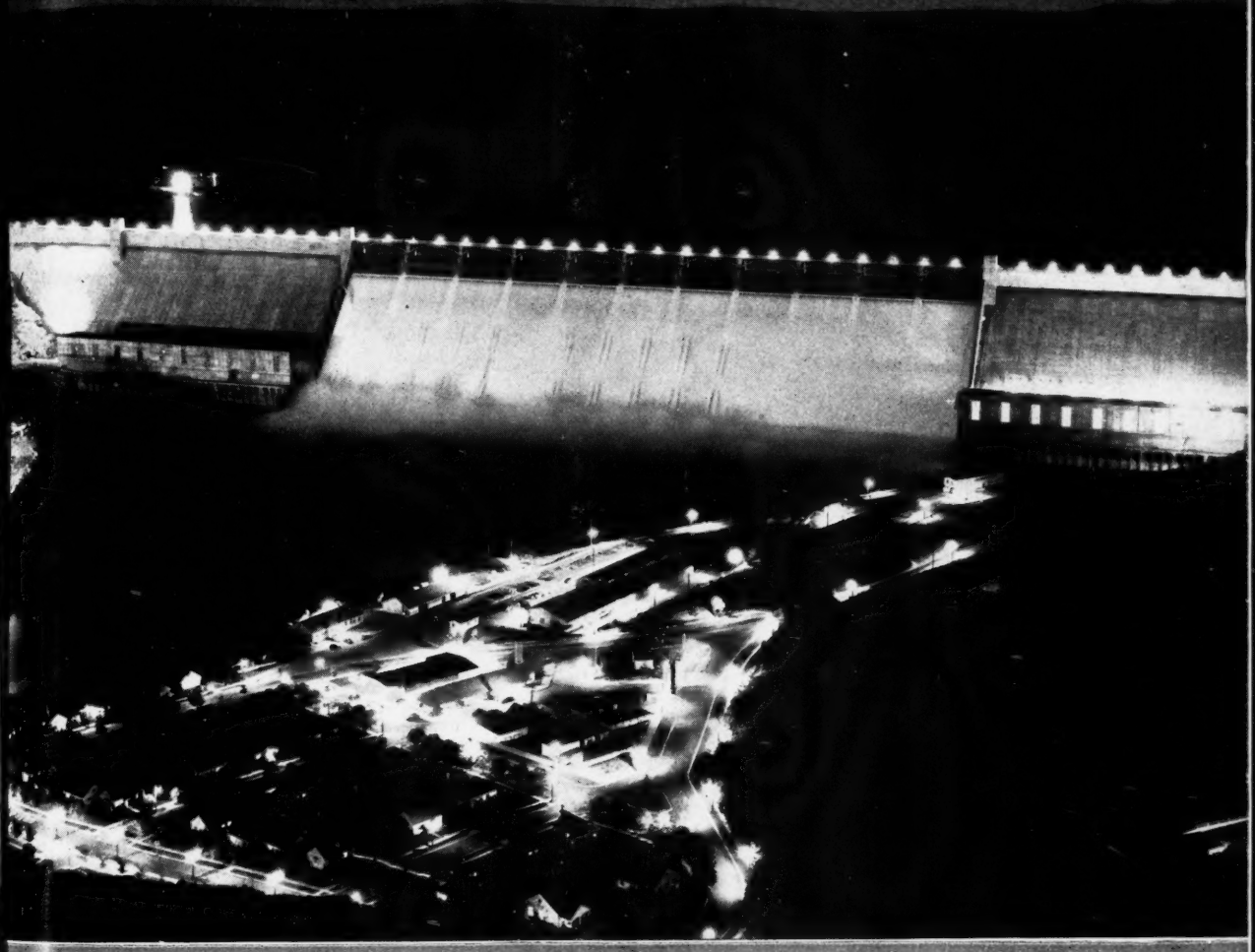
POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



Diesel Improvements at Sterling, Kansas
High Interrupting Capacity Fuses, Part 2
Coal Segregation In Boiler Plants
Boiler Fireman's Handbook
Package Type Power Plants

For Other Articles See Contents Page 5

AUGUST
1944

ELLIOTT-

Above, an Elliott geared multi-stage turbine, as built for marine generator drive. At left, Elliott standard single-stage mechanical drive turbine.

TURBINE-GENERATORS • MECHANICAL DRIVE TURBINES • ENGINES
ENGINE-GENERATORS • MOTOR-GENERATORS • MOTORS • GENERATORS
CONDENSERS • STEAM JET EJECTORS • DEAERATORS

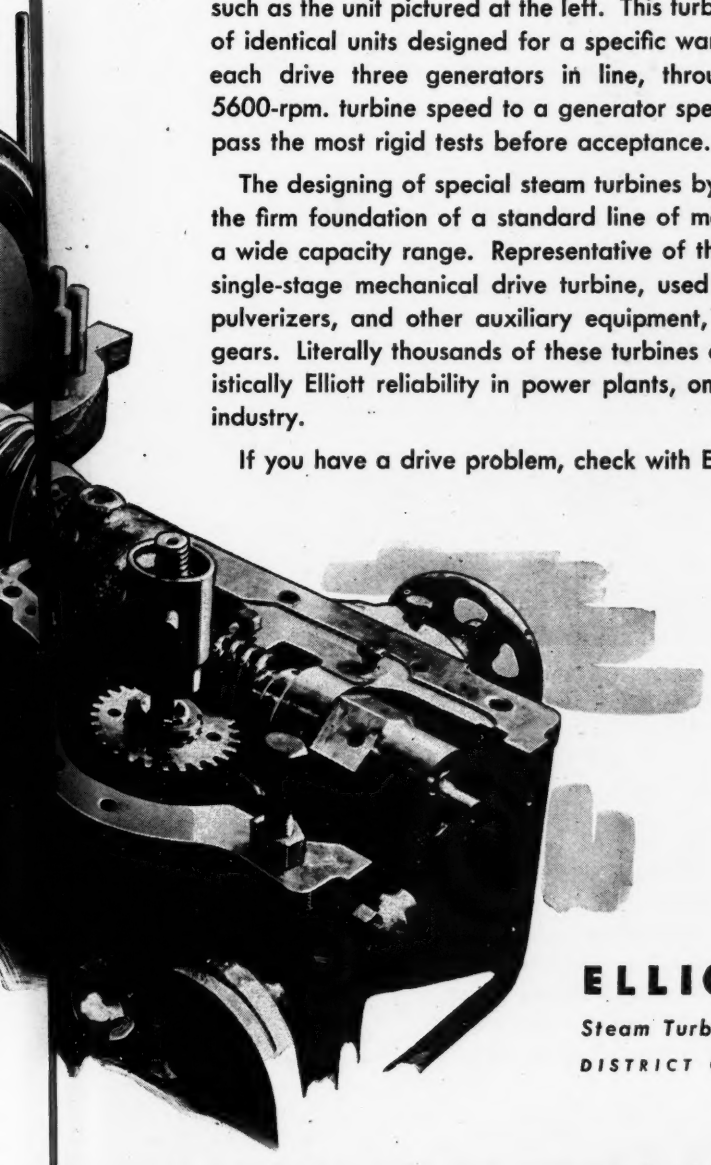
-for Turbines

STANDARD OR SPECIAL

"Tailored to the job" has become a stock phrase in speaking of Elliott steam turbines. So many of them are engineered for special conditions, such as the unit pictured at the left. This turbine is one of a large number of identical units designed for a specific wartime service. These turbines each drive three generators in line, through gears which reduce the 5600-rpm. turbine speed to a generator speed of 1200 rpm. They must pass the most rigid tests before acceptance.

The designing of special steam turbines by Elliott engineers starts from the firm foundation of a standard line of machines in several types and a wide capacity range. Representative of this standard line is the Elliott single-stage mechanical drive turbine, used with pumps, fans, blowers, pulverizers, and other auxiliary equipment, direct drive or with built-in gears. Literally thousands of these turbines are demonstrating characteristically Elliott reliability in power plants, on board ship and throughout industry.

If you have a drive problem, check with Elliott engineers.



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Steam Turbine Department, **JEANNETTE, PA.**

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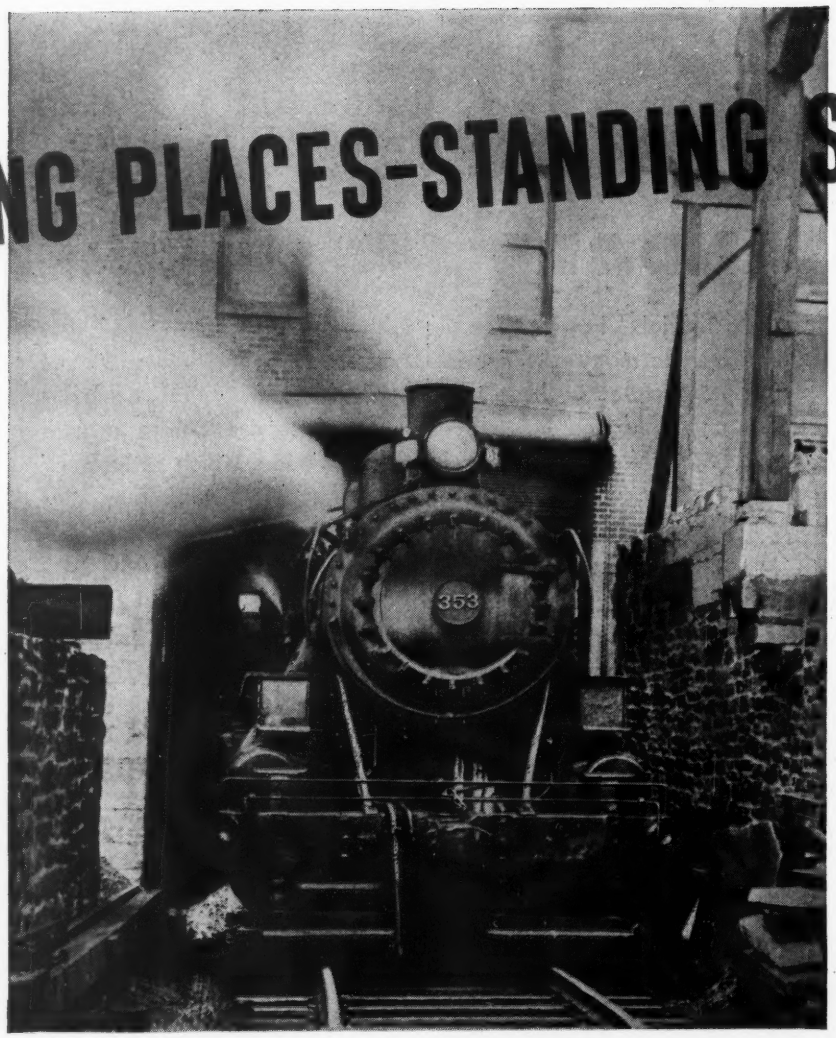
GOING PLACES-STANDING STILL



WITH a full head of steam, this locomotive is doing a vital war job without even turning a wheel. The reason—it's pinch-hitting for a factory boiler under repair.

However, keeping steam plants in continuous 24-hour operation requires more than ingenuity. Operators everywhere find they can get full-time, full-power output from their reciprocating engines by using Texaco steam cylinder oils.

Whatever the steam temperature or pressure, in engines old or new, there is a Texaco steam cylinder oil that will atomize completely, adhere to cylinder walls, separate rapidly from exhaust; assure quiet operation and low oil consumption.

Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

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TEXACO Steam Cylinder Oils

FOR EVERY STEAM CONDITION

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Contents, August, 1944

VOLUME 48—NUMBER 8

Cover: Grand Coulee Dam, with its huge 800,000-kw power plant and its spectacular waterfall, presents a striking picture after dark. In the foreground are the streets of Coulee Dam, the model Bureau of Reclamation town. On the basis of the comparative output since the first of the year, the Grand Coulee plant is the world's largest power producer

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Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

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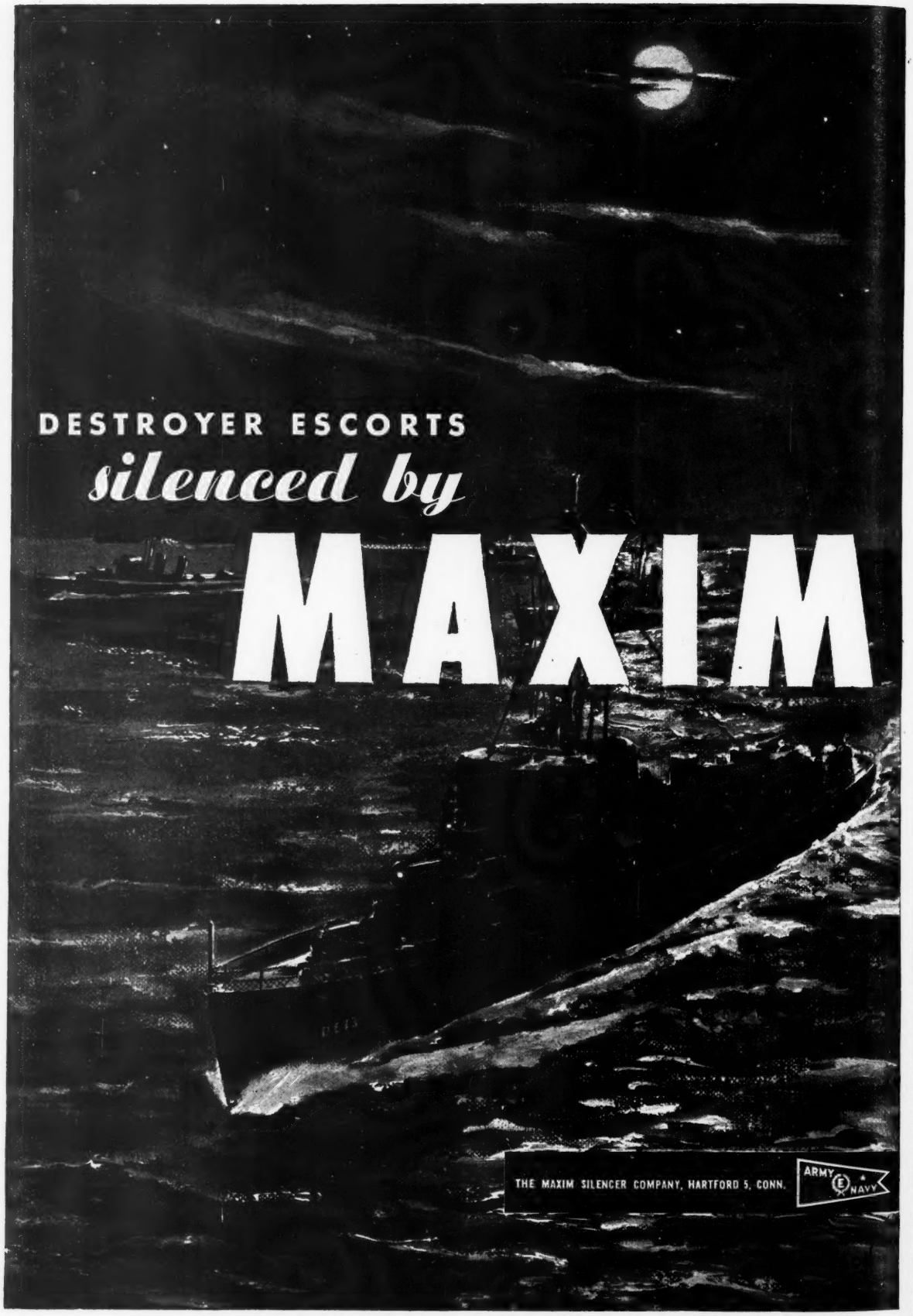
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FRONT LINES

CORROSION is the saboteur of chemical industry equipment just as it is of many types of power engineering equipment. To help chemical engineers keep it under control Crane Co. and other leading producers are doing everything they can to assist users of equipment in the battle against this invisible saboteur. The story of what they are doing and have done in the past is well told by L. G. Vande Bogart, research engineer of Crane Co. in the "Valve World," May 1944. This discussion is illustrated with a particularly interesting three color chart showing the effect of various chemicals on various metals. Many of the chemicals shown on this chart are, of course, not found in power engineering equipment but many others are. If you have problems in handling chemicals, either in the power plant or in the industry it serves, Crane Co. has a limited number of eight-page reprints of the color charts which may be obtained without charge upon request to "Valve World," Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.

A NUMBER OF years ago when inspecting power plants to get detailed data on the equipment for plant descriptions, we were always much amused to read on the nameplate of a 50,000 kw turbine generator the following inscription, "This equipment not licensed for use in aircraft." But if 50,000 kw turbines are not permitted in airplanes, steam boilers are permitted for heating water by utilizing the engine exhaust gases. These are, of course, small boilers but some extremely interesting data on their construction are given in an article entitled "Arc Welding in Airplane Boiler Fabrication," by H. A. Lebert and S. B. Willoughby in the "Welding Journal" for May 1944. As explained in that article, one of the big problems in all airplane construction is vibration. This vibration in certain cases caused failure of tubes in these small heating boilers and has led to some interesting methods of constructing the boilers.

YES, YES—we know, we know. It's Leonardo *da* Vinci, not *di* Vinci.

THE SHAPE OF THE FUTURE, as it has already begun to appear, is outlined in a very interesting booklet entitled What's New, recently published by Radio Corporation of America. This booklet merely lists, in a line or so, and without detailed description, a number of the possible future developments of industrial science. Some are already in limited use, others can be carried out with existing materials and knowledge as soon as they can be released from war service. And just to list them requires 21 pages! Unfortunately, you who are reading this will probably not use many of them. You are ham-strung by the "cultural lag," which averages about 20 years. But your children and grandchildren will use most of them. Here are typical examples: Solar heat traps for the home; home air conditioning; refrigerators with compartments at various temperatures; electric heating of soils for special crops; use of plant hormones; use of ultraviolet lamps for sterilizing food; edible fats from petroleum; glass and paper clothing and plastic shoes; the new ideas in motor-car design; glider trains, the helicopter and family planes; free flying instruction in public schools; lighter, faster and safer railroad trains and ships; micro-film books; portable two-way radio, the "walkie-talkie"; television in home, school, church, business. Get a copy of this booklet from the Radio Corporation of America, RCA Building, New York, and check it up 20 years from now.

THAT TWO ELEMENTS not now frequently considered basic metals may become so in the future was a recent prediction by A. A. Bates of the Westinghouse Research Laboratories speaking before the Machine Tool Forum at Pittsburgh in May. These two elements, he said, are manganese and titanium. The three basic structural metals, he said, are iron, aluminum and magnesium. Mr. Bates stated that for the next few years we will hardly ever encounter the results of his prediction even if it does begin to come true. Manganese and titanium are both plentiful elements of nature, are both elements not too difficult to recover, although somewhat difficult to recover in a purified state, and both have physical properties of value as structural metal. He also discussed the ways in which the Machine Tool Industry may be affected by developments in some field that apparently is not remotely connected with it, as the field of paint. For example, twenty-five years ago one of the greatest bottlenecks in automobile production was the technique of painting cars, which was very slow. By speeding up that technique the automobile has become one of the products of most interest to machine tool men.

IF YOU WANT TO KNOW what World War III will be like, take a quick glance at the American B-29 bombing plane and the German robot bomb—and then turn away with a shudder. What? You don't want another World War? Do you think the human race has yet become civilized enough to get what it says it wants or doesn't want? It says it wants peace and happiness but it continues with monotonous regularity and tremendous skill to do all the things that produce unrest and unhappiness. Well, if you don't want the 1955 version of the B-29 and the robot bomb to obliterate your children and their children, you'd better start doing something about it—FAST! About 15 years ago, in his book The Shape of Things to Come, H. G. Wells predicted that World War II would break out "about" 1940. Now another Welles—Sumner Welles—in a new book The Time for Decision, argues that the Germans are plotting World War III after losing this one. Think fast and hard, America!

The Container Shortage Is Real!

Every industry uses wrappings and cartons for both military and civilian products. A 75 mm shell requires 1.8 lb of paperboard for its protective container. Food, medicine, blood plasma—in all, 700,000 different kinds of items are shipped to the Army in paper or paperboard containers. To make them, the mills need about 667,000 tons a month, can get only about 585,000 tons a month of pulp, because of woods labor shortages. To make up the difference, we must:

1. **Salvage all waste paper, especially brown paper and paperboard.**
2. **Re-design cartons for minimum pulp content per unit moved.**
3. **Re-use cartons.**

Read carefully WPB orders L-317 and P-146. Get in touch with your regional WPB office for further details.

Salvage All Paper, Especially Brown Paper

DEPARTMENT OF LIBERAL EDUCATION in the House Organs in 15 minutes a Day:—Shoes That Kick Sea Water Must Be Tough, story of how Monel shoes prevent destruction of bronze impellers of condenser circulating water pumps handling sea water at Long Beach Station of Southern California Edison Co.; Nickelsworth, 3d quarter, 1944; The International Nickel Co. * * * Steel Pontoons Pave the Way for Invasion; Public Works Planning in War and Peace; Steel Construction Digest, July, 1944; American Institute of Steel Construction * * * Microradiography—New Tool of Metallurgy, illustrated article explaining principles and applications; Selecting Odors, results of survey of human preferences for smells of various flowers, spices, fruits and the like; Locating Instruments, an article on the difficulties of obtaining certain types of scientific instruments needed in war research; The Frontier, June 1944; Armour Research Foundation * * * Better Grinding With Clean Coolant, showing typical methods of cleaning it; Basic Information on Coated Abrasives, Part I; Grits and Grinds, Volume 33, No. 5; Norton Company * * * Invented by Babbitt, interesting illustrated story of a Cape Cod family that has been making improvements in the industrial field for generations, of which the sprocket rim for remote operation of valves and other equipment is typical; The Power Specialist, Vol. 20, Nos. 3-4, 1944; Johns-Manville * * * Thermo-Dam-Nonsense, a humorous but practical discussion of why evaporating a pound of water at 80 F in the proper way will produce the same effect in cooling air as melting 7¼ lb of ice; Parks' Parables, May, 1944; Parks-Cramer Co. * * * La Voisier—An Estimate, a detailed analysis and appraisal of the life and work of The Father of Chemistry by Lammot du Pont; The du Pont Magazine, June-July-August, 1944; E. I. du Pont de Nemours & Co., Inc. * * * Sailor's Dream, an aluminum-hulled sailboat, 24 ft 2 in. overall length, 4 ft 6 in. beam, sail area 175 sq ft in mainsail and jib, weight 700 lb of which 300 is in an aluminum fin keel and lead ballast; Aluminum News-Letter, June 1944; Aluminum Company of America * * * Tube Cleaner Storage Idea; Turbine Drives and Deaerating Heater in Paper Mill Plant Modernization; Superheat and Desuperheat in Canadian Textile Mill; Powerfax, Summer, 1944; Elliott Company * * * Good-bye to Heat Oxidation, picture story showing how life of iron and steel heat treating equipment is increased from 200 to 800 per cent; Beverages and Bullets, manufacture of both aided by metallizing; Metco News, March-April, 1944; Metallizing Engineering Co., Inc. * * * Clamping Force, the silent partner in riveted-joint dependability; How Tight Should a Bolt Be, Part II; Fasteners, Vol. I, No. 2, 1944; American Institute of Bolt, Nut & Rivet Mfrs. * * * Aluminum Welding, by low-temperature methods; The Eutectic Welder, July 1944; Eutectic Welding Alloys, Inc. * * * Sulzer monotube steam generator plant at a coal mine in the north of France, complete description, with cross-section, of unit for generating 220,000 lb of steam per hour at 2200 psi, 932 F; Sulzer Technical Review, No. 3, 1943; Sulzer Bros. Ltd.

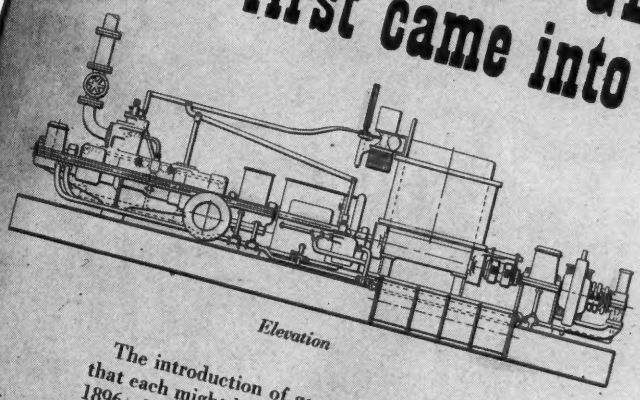
FRANK LLOYD WRIGHT put it crisply the other day when he said, "If the United States doesn't get busy on better housing, better city planning for after the war, it will, within five years from the armistice, be the Old World and Europe the New World. Great areas of Russia, Poland, The Netherlands, Germany, Italy, England and Czechoslovakia will be rebuilt from scratch with modern ideas, absence of slums, wide spreading of houses to avoid congestion and to make room for the automobile. Plastics, light strong economical household inventions, products of modern science, will be cheaper and quicker for the rebuilt areas. Meanwhile, we in America will merely make a few superficial changes in our kitchens and go on wedded to expensive, cramped life in our present old-fashioned cities. It will be the world's most profound psychological change in 300 years if youth starts to emigrate to Europe from America."—Sydney J. Harris in the Chicago Daily News.

PARALLEL development in a coordinated program of both Diesel engines and their superchargers to produce smaller, lighter, more powerful Diesels, was suggested at the recent Chicago SAE meeting by E. W. Wasielewski, of McCulloch Engineering Corp., Milwaukee, Wis. He presented comparative charts showing the relative efficiencies resulting from Diesel engine design progress. He declared the time has come for integrating superchargers with high-speed Diesels to take full advantage of their potentialities for making possible more compact and lighter engines. High supercharger efficiency is of greater importance in the high speed engine than in the low speed Diesel, he explained, and the future need will be for superchargers of high performance at larger pressure ratios. Further work is required to permit of the use of higher manifold pressures and rotational speeds, he added, and supercharger development must be carried out at the same time to insure maximum progress.

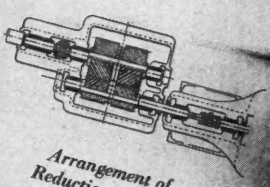
MODERN REFINERIES and chemical plants require accurate control of all materials and processes. Many products are made continuously—thus if an error creeps in, thousands of gallons or hundreds of tons of material will be spoiled if correction is not made speedily. Production of high-octane gasoline, butadiene, or styrene, for example, involve precise critical processes. Laboratory-accurate on a huge scale, they need controls that are both exact and rapid. Westinghouse Research Laboratory has developed a new control mechanism that fulfills the requirements. Previously, chemical tests in an oil refinery have been laborious and have required hours to complete. The new device, the mass spectrometer, thoroughly checks operation in a matter of minutes—and requires only one or two technicians. It determines both qualitatively and quantitatively the constituents of a gas. With substances that are alike chemically and differ only slightly in weight, chemical analyses are extremely difficult. The mass spectrometer uses only a small quantity of the gas—it need be only a thimbleful—and ionizes it by impact of electrons from a hot filament in an evacuated tube. The stream of charged molecules is drawn along the tube into a strong magnetic field, where it is bent into an arc-shaped path. The heavier the ion, the larger the radius of curvature of its path. As a result, different molecules emerge from the field at various locations—but all of the same kind leave at one particular spot. Different charged molecules are collected at an exit slit into a current that can be amplified and measured. In this way, constituents of any gas can be determined as to kind and proportion. The device can readily detect, for example, the presence of one part of oxygen in 10,000 parts of nitrogen. It is expected to have many industrial uses.

THE "QUIETEST ROOM IN THE WORLD" has been built for checking the performance of sound and radio equipment. In this room, one can hear his voice as it really is without distortion from reflection or other sounds. The silence is so profound, reports The Ohmite News, that the small sounds produced within one's own ears by the living processes may be heard.

A 1-Job oil was all right when REDUCTION GEARING first came into vogue



Elevation



Arrangement of Reduction Gearing

The introduction of gearing between the turbine and the generator in order that each might be designed to run at a favorable speed was made in February, 1896. It was then that the 150 kw geared turbo-alternator shown above was supplied to a British Power Station. The turbine ran at 9600 rpm and drove its alternator at 4800 rpm, producing single-phase current at 1000 volts and 80 cycles.

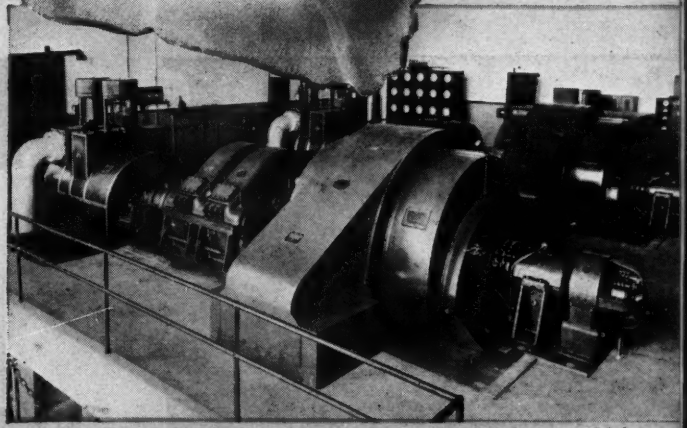
It was designed to work with saturated steam at 70 lb. gauge pressure to exhaust into a condenser with a vacuum of 26.8 in. This same year these same manufacturers sent the first turbo-alternator to America—a 120 kw machine operating at 5040 rpm. It was the first turbine ever commercially used in the United States, with the exception of some very small machines constructed by Professor Sweet on the lines of the original aeropile of Hero.

...*But* modern geared turbines need this *2-JOB* oil!

1—That Prevents Rust
2—That has Superior Oxidation Stability

A turbine oil, in addition to lubricating the bearings and governor must also lubricate the reduction gears. Actually the oil must meet 2 different kinds of operating conditions: the terrific rubbing speeds and heavy tooth pressures of the gears, and the high pressures and steam temperatures encountered in the turbine itself. The only oil that can do this complicated job with efficiency and economy is a 2-job oil . . . one that *prevents rust* and at the same time *resists oxidation* to an unusual degree. Shell Turbo Oil does both.

How good a job it does is evidenced by the outstanding record it is building for itself in all types of turbine operation. A record that shows it to be the first of its type to be approved as meeting U.S. Navy specifications. A record that shows it has often succeeded where other oils have failed. A record we'd like one of our men to show you. Write: Shell Oil Company, Inc., 50 West 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif.

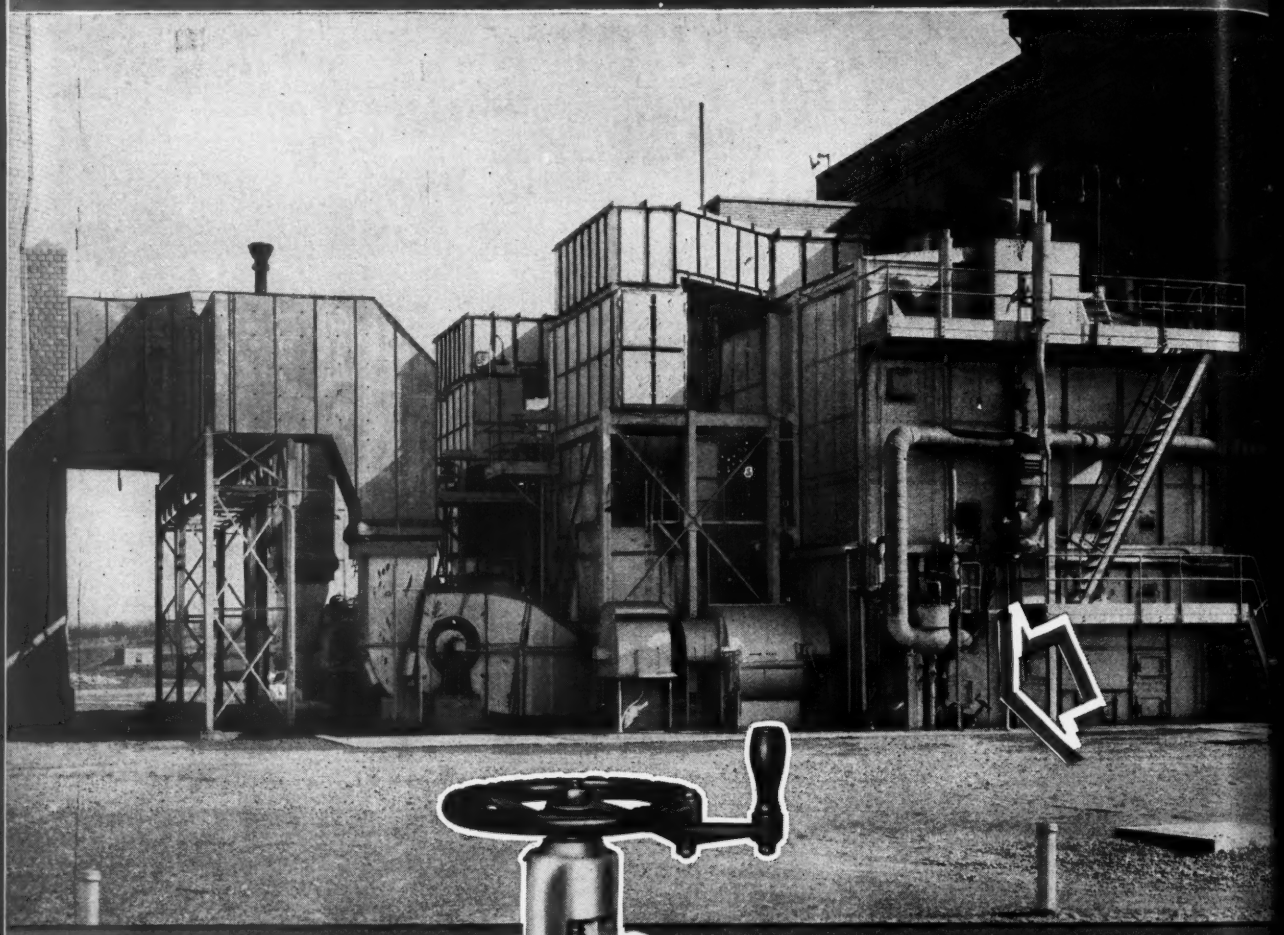


Today's high-pressure geared turbines need more than a good lubricant. They need the unusual characteristics of Shell Turbo Oil . . . the 2-job oil that prevents rust; has superior oxidation stability.

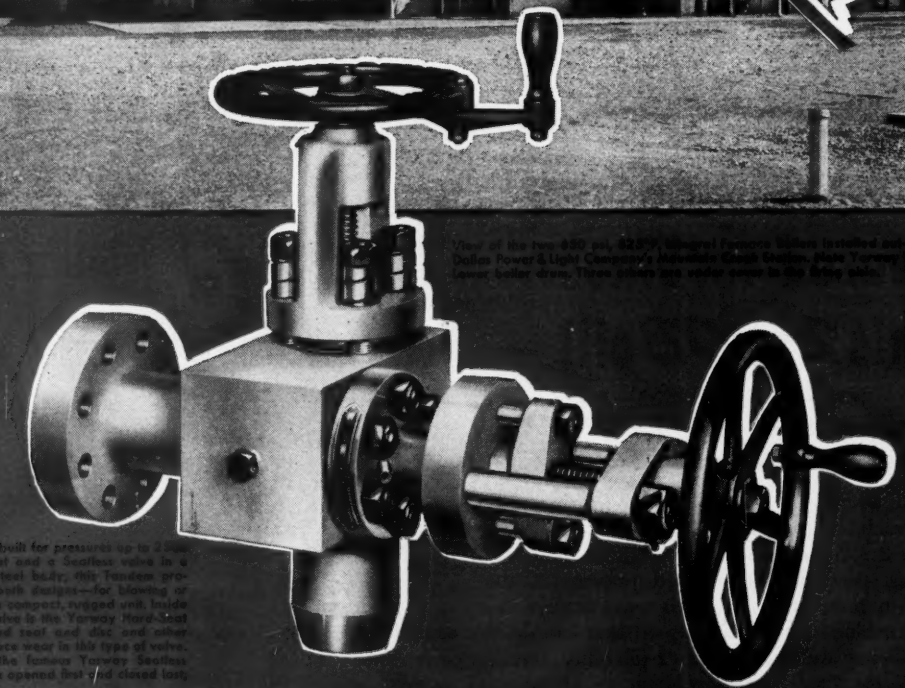
SHELL

TURBO OIL

"Outdoor Power Plant"



View of the new 650 psi, 825°F Riley-type Furnace Boilers installed out-of-doors at the Dallas Power & Light Company's Mountain Creek Station plant. Yarway Unit Tandems on lower boiler drum. Three inlets are under name on the firing aisle.



Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or draining and sealing—in a compact, rugged unit. Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve with special Stellited seat and disc and other features which greatly reduce wear in this type of valve. Outside sealing valve is the famous Yarway Seatless design. This valve is always opened first and closed last, maintaining a tight seal.

YARWAY

selects YARWAY Unit Tandems

A power plant, literally, with no "overhead"! That is Dallas Power & Light Company's Mountain Creek Station, where two 650 psi, 825° F. Integral Furnace Boilers handle a capacity load of 400,000 lb of steam per hour, out in the open with only the firing aisle under cover.

The selection of Yarway Unit Tandems for this unique installation was undoubtedly influenced by the satisfactory performance of Yarway Valves at the Dallas Station where they have been in use for 18 years.

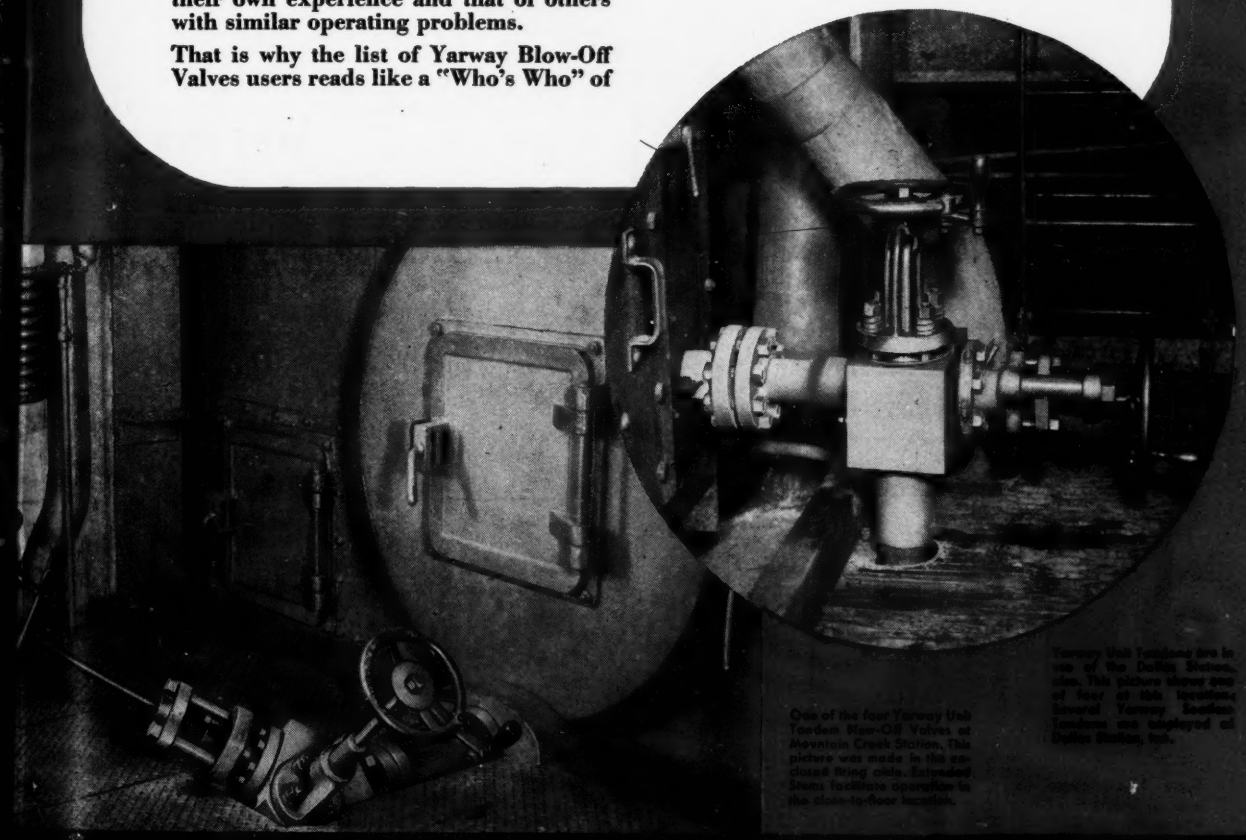
Careful purchasers buy on experience—their own experience and that of others with similar operating problems.

That is why the list of Yarway Blow-Off Valves users reads like a "Who's Who" of the leading Utilities, Industrials and Institutions of America.

What are your blow-down or draining and sealing problems? Play safe and select Yarway Valves—the best insurance against trouble and expense and resultant costly shut-downs.

Write for Catalog, Section B-431 for pressures from 400 lb to 2500 lb. Section B-424 for lower pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

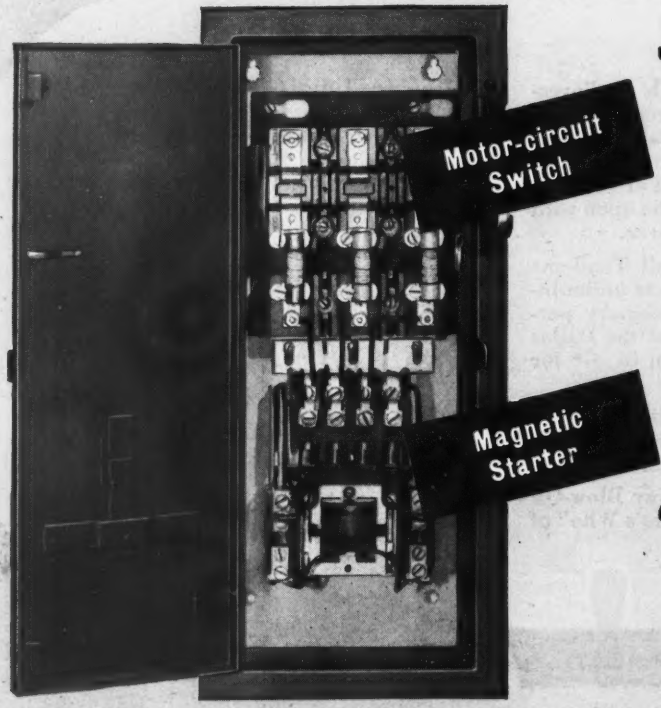


One of the four Yarway Unit Tandem Blow-Off Valves at Mountain Creek Station. This picture was made in the enclosed firing aisle. Extended Stems facilitate operation in the close-to-floor location.

Yarway Unit Tandems are in use at the Dallas Station pictured. This picture shows one of four of this type where Yarway Tandems are employed at Dallas Station, too.

BLOW-OFF VALVES

EVERYTHING YOU NEED to



110 to 600 Volts

GE

COMBINATION STARTER

Why two devices? ONE can do the job.

GENERAL PURPOSE	CORROSION-RESISTANT	DUST-TIGHT	FOR HAZARDOUS LOCATIONS	WATER-TIGHT
Type 1 enclosure for indoor applications where atmospheric conditions are normal. Available up to and including NEMA Size 5.	Two forms are available —Type 3 for corrosive atmospheres; Type 8 for hazardous locations. All arcing parts and terminals of Type 8 forms are at least six inches under oil.	Type 5 enclosure for use in steel mills, cement mills, and other locations where the dust content of the atmosphere is so high as to make a dust-tight case desirable.	Type 7 case for Class I, Group D, locations is made of cast, high-strength alloy. Designed to withstand internal explosions.	Type 4 case is suitable for outdoor use, and for damp places indoors; such as dairies, breweries, and piers.

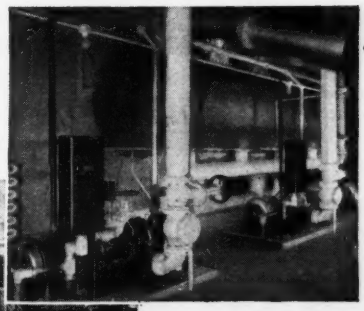
control and protect your motor in ONE COMPACT CONTROL UNIT

COMPLETE full-voltage control of squirrel-cage motors or the primary control of wound-rotor motors—with extra safety, very low installation cost, good appearance, and other advantages.

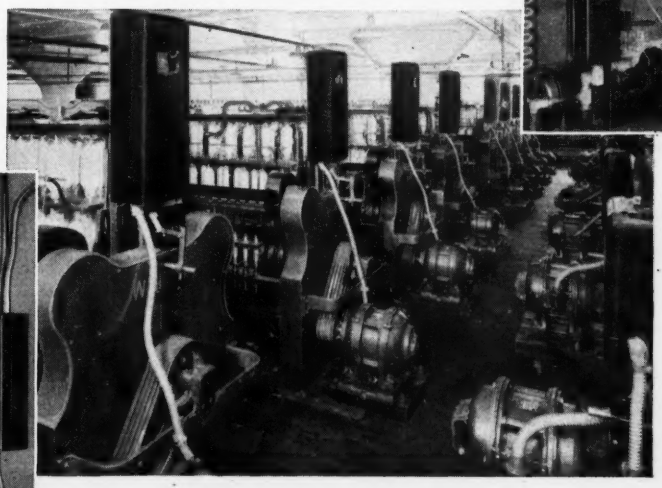
Which Type Do You Need?
If you want short-circuit protection, you can select a starter which has a fusible motor-circuit switch or a breaker to provide such protection. Or, if you do not need short-circuit protection, you can choose a starter which is equipped with a nonfusible motor-circuit switch that serves only as a disconnect. Both types are available in a variety of enclosing cases, as shown on the opposite page.

Co-ordinated for Protection
With G-E combination starters, you're sure that the motor-circuit switch or breaker has the proper rating for the magnetic starter with which it is used. The fuses or breakers provide adequate short-circuit protection to the motor, the starter, and subsequent motor-branch-circuit conductors when connected to a power supply for which they are recommended. The co-ordination of thermal overload relays with the fuses or breakers affords complete motor overcurrent protection under any condition of operation.

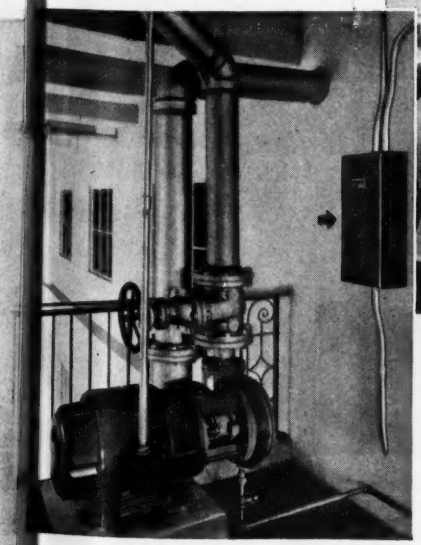
Increased Safety
By placing the motor-circuit switch in the same case with the magnetic starter, the switch can be mechanically interlocked with the cover, so that the cover cannot be opened while there is power on the starter. This is an important advantage because, when a separately mounted switch and starter are used, there is nothing to prevent the operator from opening the case while the starter is "hot."



G-E combination starters can be mounted on or near the machine even in damp locations, such as this pump-room installation.



This combination starter controls a ball-bearing splash-proof motor direct-connected to a centrifugal mash pump in a brewing plant.



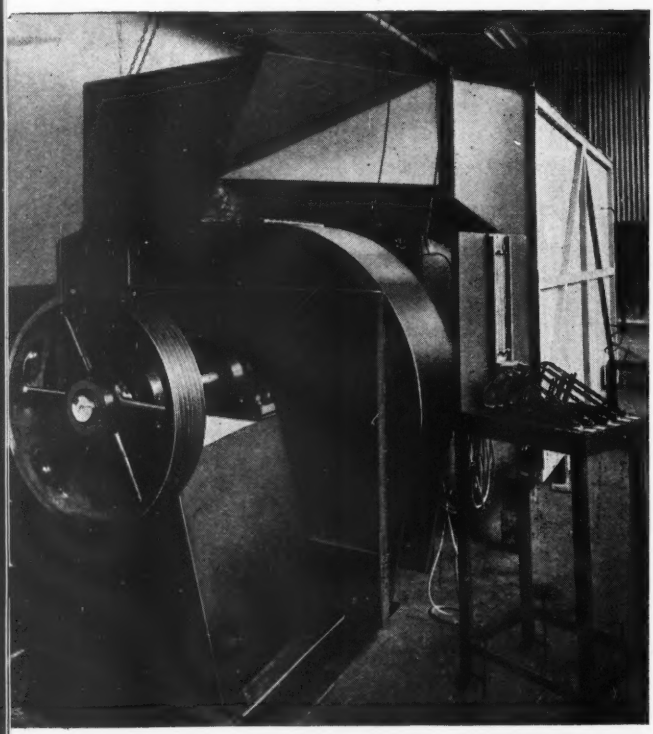
Combination starters and shipper-rod switches are used to control the operation of each frame operated by this spinning-frame drive.

WANT MORE DATA? More complete information on G-E combination starters will be found in Bulletin GEA-3715. Ask our nearest office for a copy or write direct to General Electric Company, Schenectady 5, N. Y.

Every week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds

GENERAL ELECTRIC

Progress and Power in the



A test conducted in the American Blower research laboratory to determine the air flow and resistance of a dehydrogenation catalyst case.

Tremendous progress has been made in the rubber industry. New developments . . . new processes . . . new synthetics . . . entirely new plants.

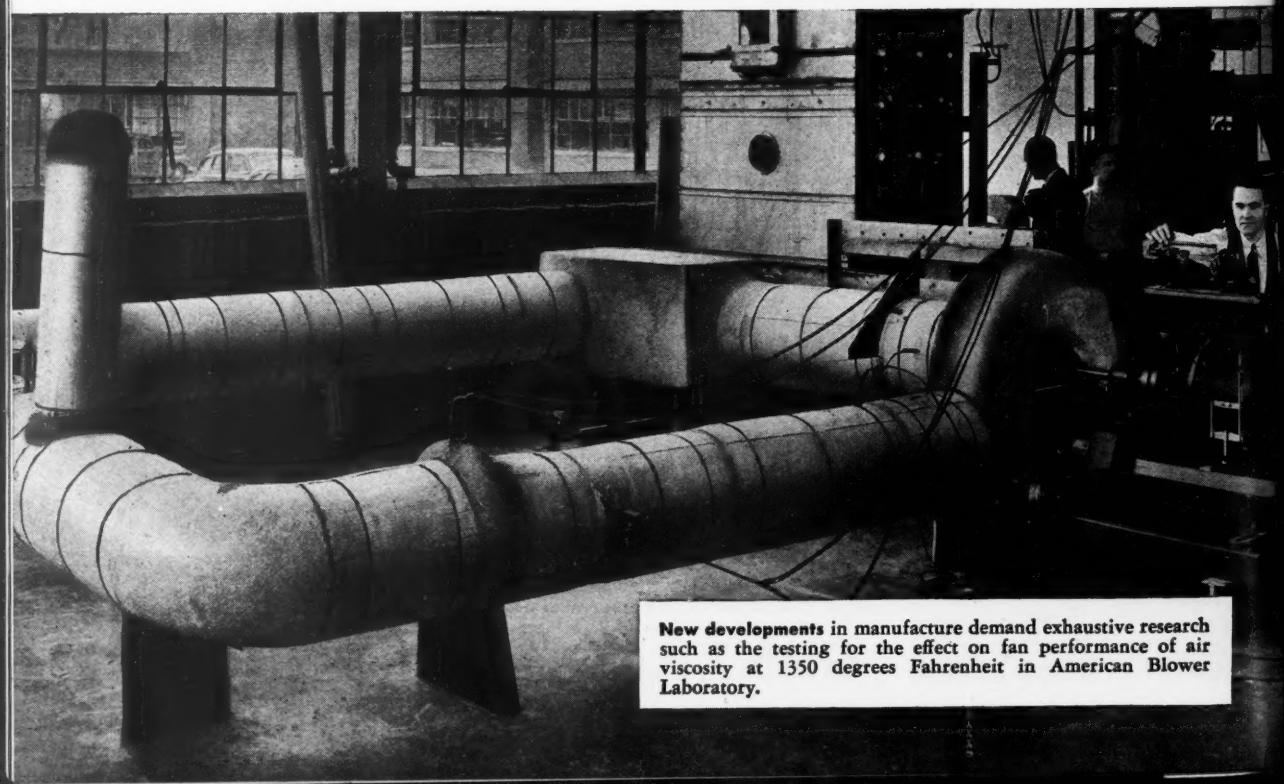
Behind this seemingly impossible task lies a story of co-operation — close co-operation on the part of machinery manufacturers and co-operation on the part of America's great Public Utilities in furnishing the added power to produce the goods.

American Blower co-operated by conducting exhaustive research studies and developing special air handling and conditioning equipment to withstand the grueling conditions of a greatly expanded rubber industry. Our knowledge gained through the years, building standard as well as specialized air handling equipment for industry, is available to you.

AMERICAN BLOWER

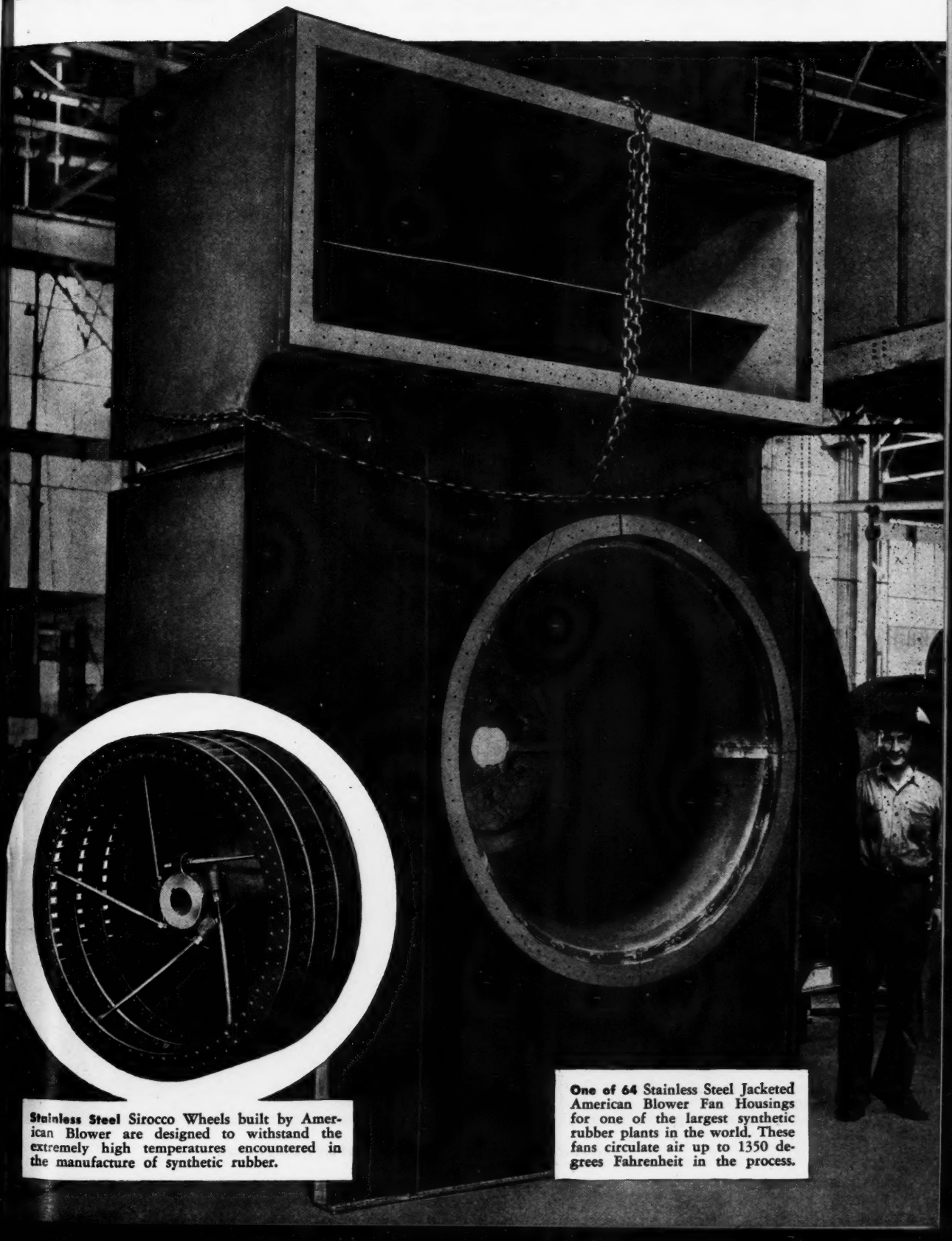
ARMY E NAVY
For Production
"Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation



New developments in manufacture demand exhaustive research such as the testing for the effect on fan performance of air viscosity at 1350 degrees Fahrenheit in American Blower Laboratory.

RUBBER INDUSTRY



Stainless Steel Sirocco Wheels built by American Blower are designed to withstand the extremely high temperatures encountered in the manufacture of synthetic rubber.

One of 64 Stainless Steel Jacketed American Blower Fan Housings for one of the largest synthetic rubber plants in the world. These fans circulate air up to 1350 degrees Fahrenheit in the process.

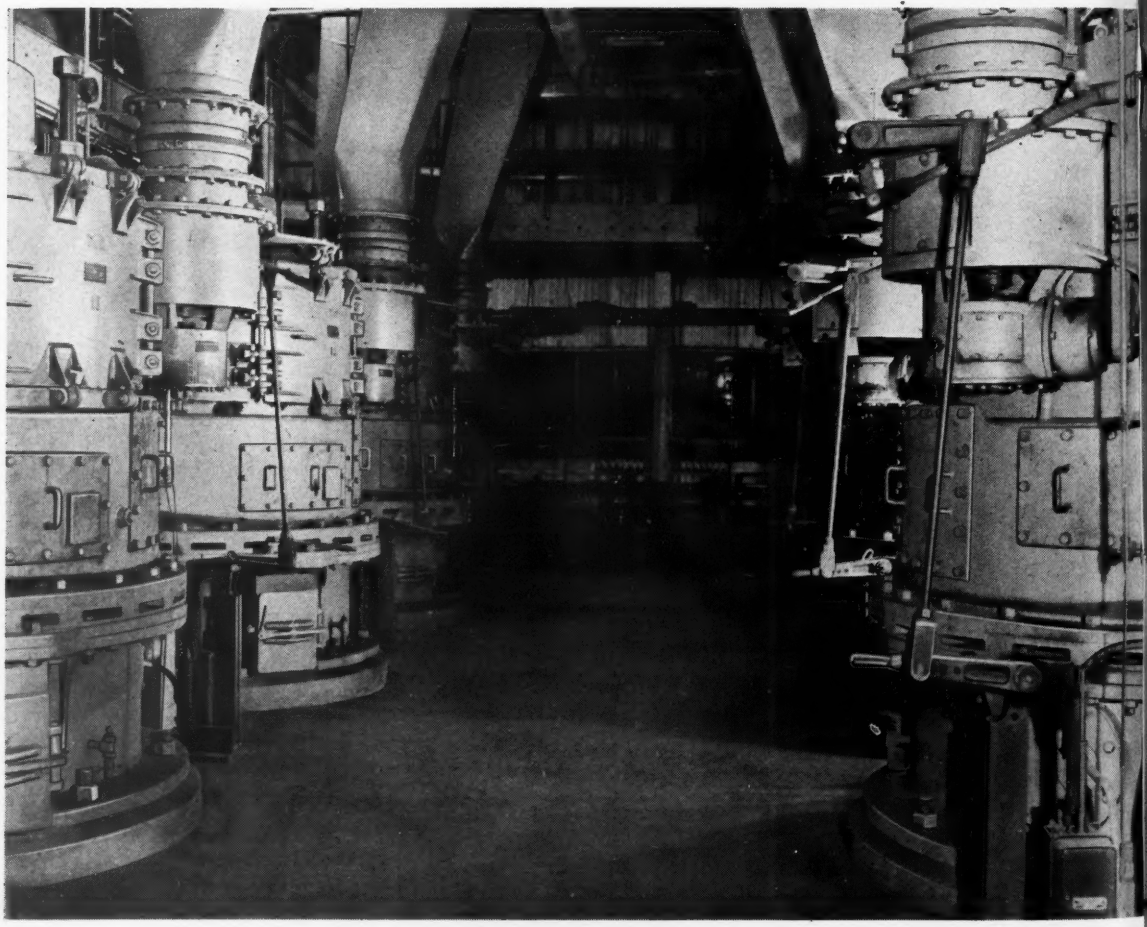
From DREAM *to* STEAM..

25-Year Vision of Ohio Electrical Pioneer Became Reality in New R. E. Burger Station

On January 21, 1944, The Ohio Public Service Company officially started up and dedicated its new modern generating station at Dilles Bottom, Ohio, on the Ohio River. It was a momentous occasion for officials and engineers of OPS. A dream had come true. More than 20 years of foresight and planning had at last become a reality. No less an achievement was the excellent service rendered by the existing plants on the system during this long period of planning, and especially during the past few years, when the demand for electric power was greater than ever.

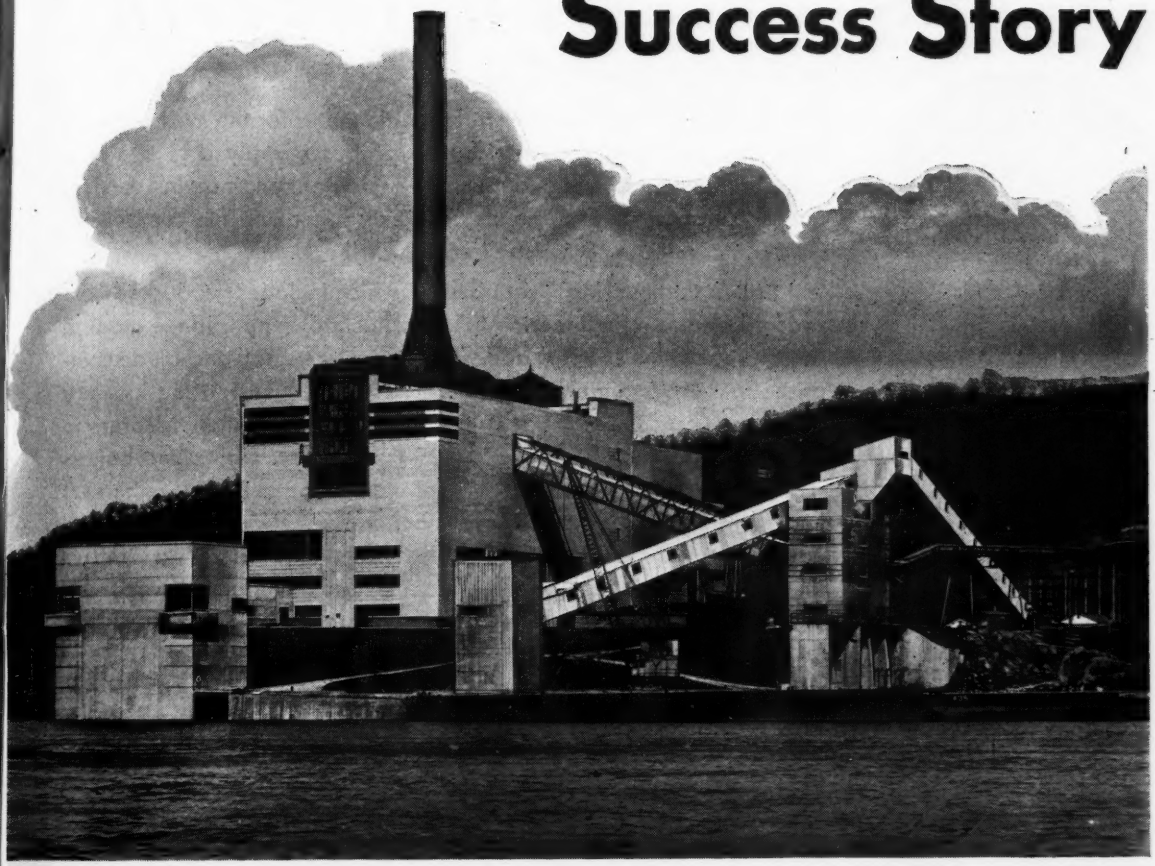
Completion of the new station was a particularly significant climax for R. E. Burger, President of Cities Service Power & Light Company. Pioneering the idea of building a central station on the site, he saw his vision and judgment vindicated as the steam throttle was opened for the first time and the 62,500-Kw turbo-generator began to hum in the plant appropriately named in his honor. It was a proud day, too, for the men who had surmounted a long chain of wartime obstacles in constructing the plant that, according to OPS President, T. O. Kennedy, "guarantees ample electricity for all war manufacturing needs in our territory. After the war, it insures all persons on our Company's lines an abundance of power enabling them to make full use of the many electrical servants—the labor-saving devices they will be able to obtain".

Babcock & Wilcox, in saluting this OPS achievement, is proud to have had a part in it by furnishing the power behind the power — the steam-generating equipment.

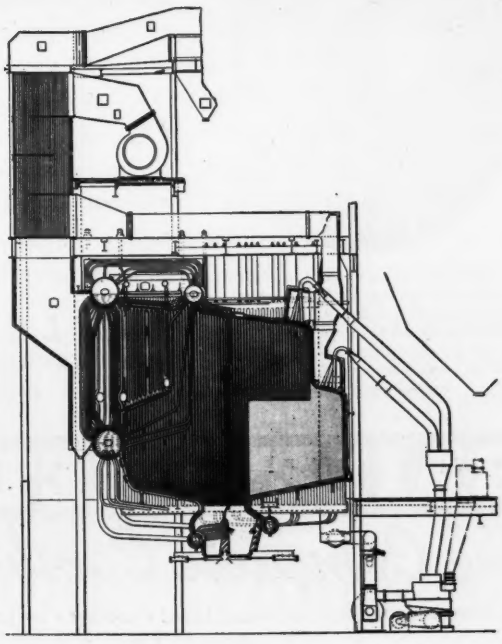


Three B&W Type E Pulverizers serve each of the Stirling Boilers.

M...a 500 Million KWH. Success Story



Two Stirling Boilers supply the steam needed at R. E. Burger Station to generate an annual power output of 500 million kwh. Each boiler has a capacity of 350,000 lb. of steam per hr. The two boilers supply the steam needed by the 62,500 kw. turbo-generator.



The
BABCOCK & WILCOX Co.

85 Liberty Street New York 6, N. Y.

G-270T

Effective Instrumentation
DEPENDS UPON *Engineering*

Bailey Field Engineers who are specialists in combustion testing and boiler control, carefully adjust each Bailey Boiler Meter and Control System to its boiler unit. This method of application insures maximum effective performance of metering and control equipment.

★ It is relatively easy to construct a ratio meter for the measurement of Steam Flow and Air Flow; but to properly apply it to a steam generating unit requires experienced, competent engineering service. Successful application depends upon skill in making the combustion tests which determine the final setting of the meter.

The Bailey Engineering Organization, which includes graduates from over 40 different Engineering Schools, has grown up with the modern boiler plant. Over 25 years ago, when units were small and crude compared to those available today, Bailey Engineers served the industry by conducting combustion tests and adjusting Bailey Boiler Meters to guide the way to maximum combustion economy. Since then, boilers and furnaces have seen many improvements and Bailey Engineers have been constantly in close contact with their development. This experience has yielded a store of "know how" which is now drawn on by Bailey Engineers in their work of adjusting metering and control equipment for optimum results. All graduate Engineers entering the employ of Bailey Meter Company receive a factory training course which includes comprehensive post graduate studies in combustion and boiler control.

Bailey Meter Company has its Engineers permanently located in over 30 cities throughout the United States and Canada. These Engineers concentrate exclusively on the application and adjustment of Bailey Meters and Control Systems. Their activities are directed by Bailey branch office managers who are well qualified Combustion Engineers of long experience. Most of these managers have been associated with the Company for over twenty years.

Through this seasoned field engineering organization, Bailey Meter Company offers Power Engineers a safe, sure way to maximum boiler steaming capacity, fuel economy, conservation of man power, and minimum outage of equipment.

For an outline of the many ways in which Bailey Meters and Control Systems serve the modern steam plant, ask for a copy of Bulletin No. 15-B.

BAILEY METER COMPANY
1040 IVANHOE ROAD **CLEVELAND 10, OHIO**
Bailey Meter Company Limited, Montreal, Canada G-16

BAILEY METER CONTROL
The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

Controlled Quality...

THROUGH ACCURATE ANALYSIS MEANS ASSURED WELDABILITY

● In the Ladish Metallurgical Laboratories, trained technicians work with the finest equipment available to insure that your Ladish Quality Forged Steel Flanges will do the job for which they are intended . . . will have assured weldability.

The heat identity code, permanently stamped on every Ladish Quality Forged Steel Flange, means that certified reports of the work of the Ladish Metallurgical Engineering Laboratories attesting the chemical and physical properties of the steel are always available upon request.

Steel identity stamped on each flange was pioneered by Ladish and has been a Ladish standard for many years.

ARMY-NAVY E

FITTINGS DIVISION

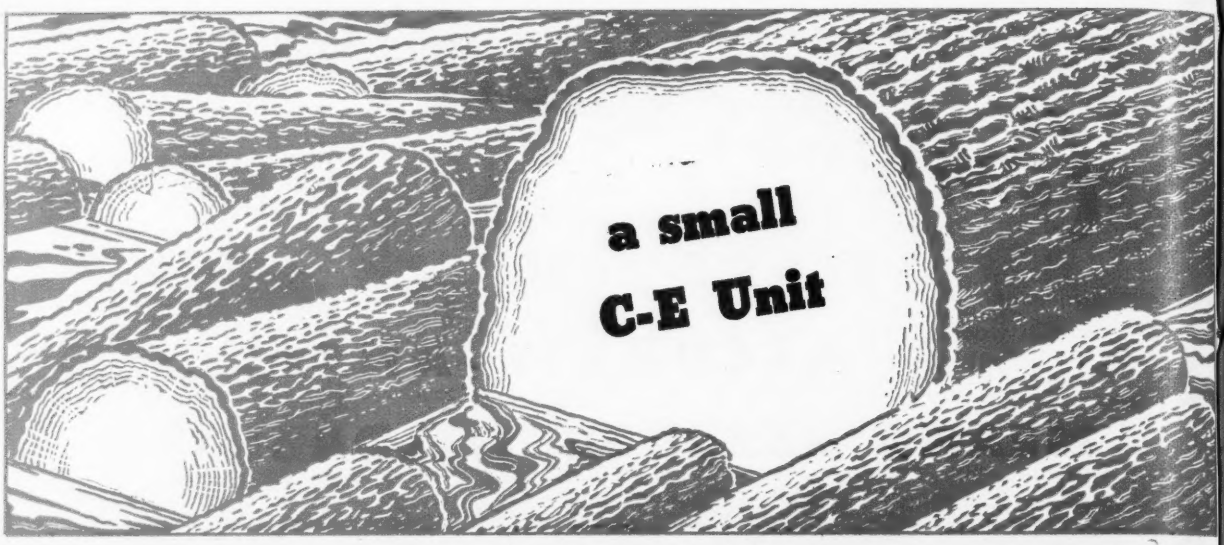
LADISH DROP FORGE CO.

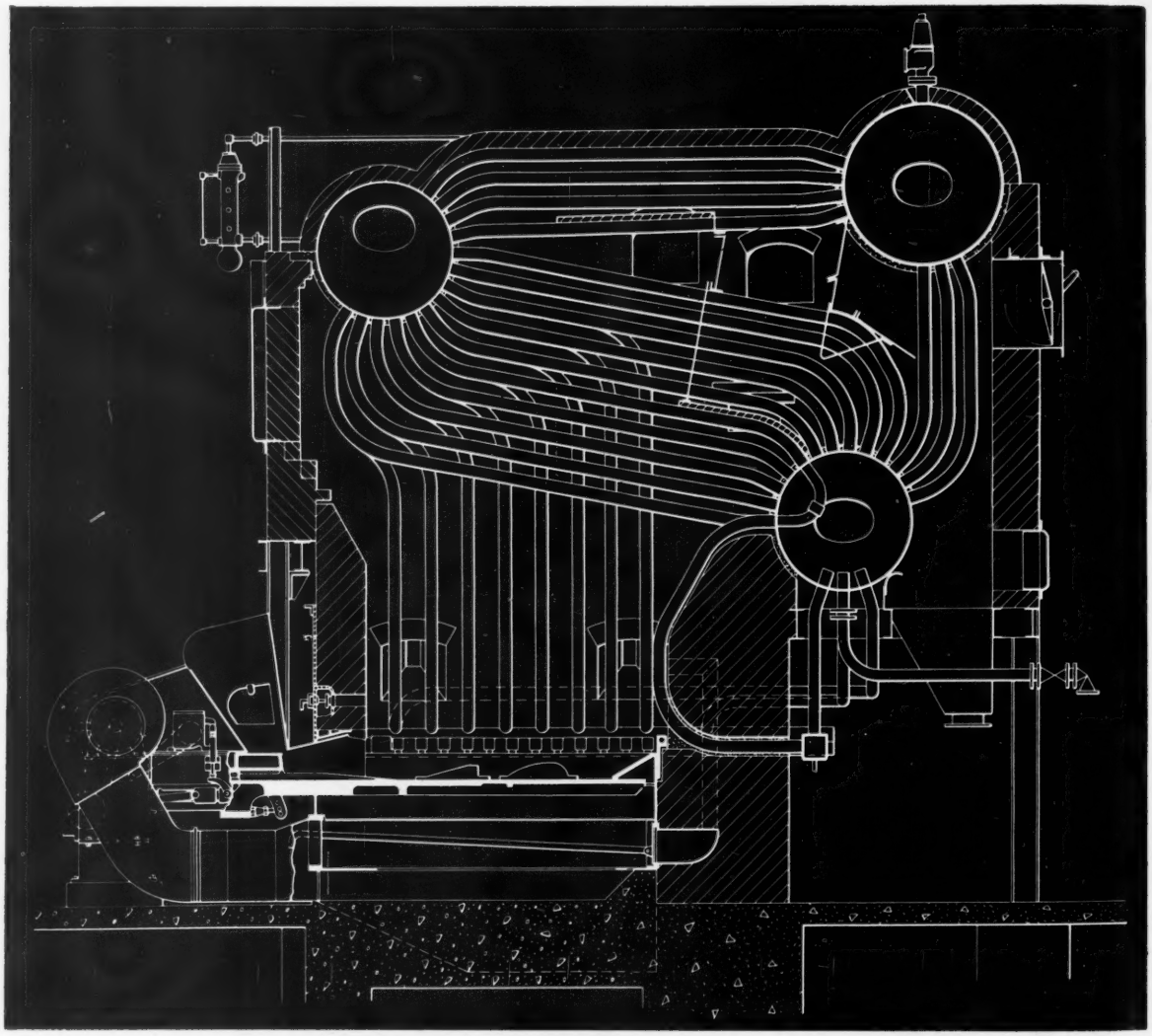
CUDAHY • WISCONSIN

MILWAUKEE SUBURB

New York Office: 60 East 42nd Street, New York City

TO MARK PROGRESS





Shown above is the C-E Unit responsible for the record on the opposite page. It comprises a C-E Bent Tube Boiler, Type VM, equipped with water-cooled side and rear walls and fired by a C-E Underfeed Stoker, Type E. Capacity 10,000 lb of steam per hr; Design Pressure — 160 psi.

IN 1940 a prominent pulp and paper company was advised by its insurance company that its old Heine boiler, built back in 1892, was about ready for retirement. The boiler was still in good condition and could have continued to operate at reduced pressures. But wartime demands were heavy and it seemed wise to retire the veteran with honor and install a new unit.

Naturally this manufacturer came to Combustion Engineering, of which the Heine Boiler Company has long been a part, for the new equipment. It was decided to install a C-E Bent Tube Boiler, Type VM, fired by a C-E Underfeed Stoker, Type E. The arrangement of this unit is shown at the left.

A recent report on this equipment reads, "This unit runs 24 hours a day and is only taken off the line every six months. Even then the longest period out of service has been 18 hours. The response of this equipment to steam demand may be judged from the fact that the pressure never drops more than 5 pounds, despite the fact that the principal load is digesters, which really *pull* steam out of a boiler."

In contrast to notable performance records of C-E industrial units recently cited that range up to 150,000 lb per hr capacity, this is a small installation – capacity about 10,000 lb of steam per hr. But large or small, C-E equipment is doing a real job all over the country. Again and again the extra values – the reserve – in C-E design and construction are demonstrated. You can assure such quality of performance for your steam needs – Specify C-E. A-800

COMBUSTION C-E ENGINEERING

200 MADISON AVENUE NEW YORK 16, N. Y.

Canadian Associates: COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver

C-E PRODUCTS INCLUDE ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; ALSO MANY TYPES OF PRESSURE VESSELS

EXTRA

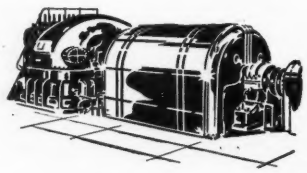
...added to a base stock that is high-grade, long-

NEW GARGOYLE

THIS great new turbine oil — Gargoyle D. T. E. Oil 797 — combines all three of the factors needed to make the ideal turbine oil — a base stock that is in itself an excellent turbine oil, maximum resistance to oxidation and maximum anti-rust qualities.

As a result, Gargoyle D.T.E. Oil 797 has already proved its superiority. In severe oxidation tests, it stood up a great deal longer than other leading turbine oils.

Now, Gargoyle D.T.E. Oil 797 is meeting today's greatly increased operating temperatures in turbines ranging from 1500 KW to 50,000 KW.



Your local Socony-Vacuum representative can give you full details about this new oil. Be sure to get the facts from him... and get Gargoyle D.T.E. Oil 797 in your turbine.

SOCONY-VACUUM OIL COMPANY, INC. • Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Co. • General Petroleum Corporation of California

FROM THE WORLD'S LEADER IN LUBRICATION:

RESISTANCE TO OXIDATION, RUST

is in itself an excellent, lasting Turbine Oil...

D.T.E. OIL!

GARGOYLE

Lubricants

WHAT MAKES A GREAT TURBINE OIL?

✓ ***Excellent Base Stock:*** The fundamental requirement for an ideal turbine oil is a base stock that in itself is an excellent turbine oil with excellent resistance to oxidation.

✓ ***Extra Resistance to Oxidation:*** Oxidation protection—PLUS—is needed to meet the effect of greatly increased temperatures in modern turbine operation. Your turbine oil should have this PLUS protection.

✓ ***Maximum Anti-Rust Qualities:*** The possibility of the presence of water demands that the oil should furnish maximum protection against corrosion. Your turbine oil should give this protection.

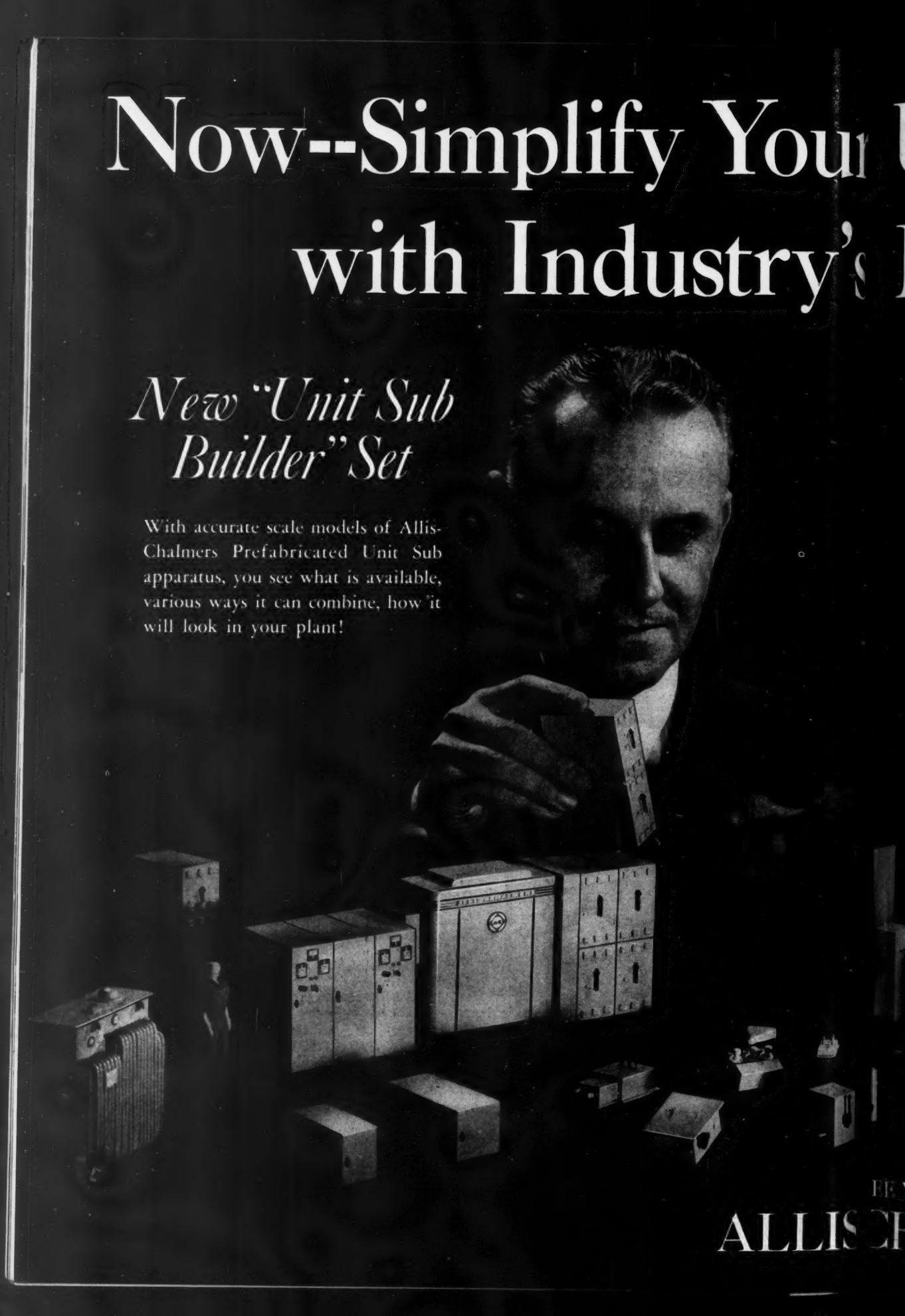
THE NEW GARGOYLE D.T.E. OIL 797 HAS ALL OF THESE NECESSARY CHARACTERISTICS

Socony-Vacuum Oil Company, Inc.

Now--Simplify You
with Industry's

New "Unit Sub Builder" Set

With accurate scale models of Allis-Chalmers Prefabricated Unit Sub apparatus, you see what is available, various ways it can combine, how it will look in your plant!



ALLIS

Unit Sub Planning Newest Aid!

GUESSWORK IS GONE from unit sub planning when you *see* the elements of Allis-Chalmers Prefabricated Unit Substations — in accurate scale models.

You plan *visually*, effortlessly — without bogging down in charts, tables, diagrams — save time, cut way down on any chance of error.

To see for yourself how the new "Unit Sub Builder" Set can help you in your power distribution planning, call your nearby Allis-Chalmers district office.

An A-C field engineer will bring the models, together with the handy new "Unit Sub Slide Rule" for calculating breaker capacity — and new "Check List" for *double* checking all details.

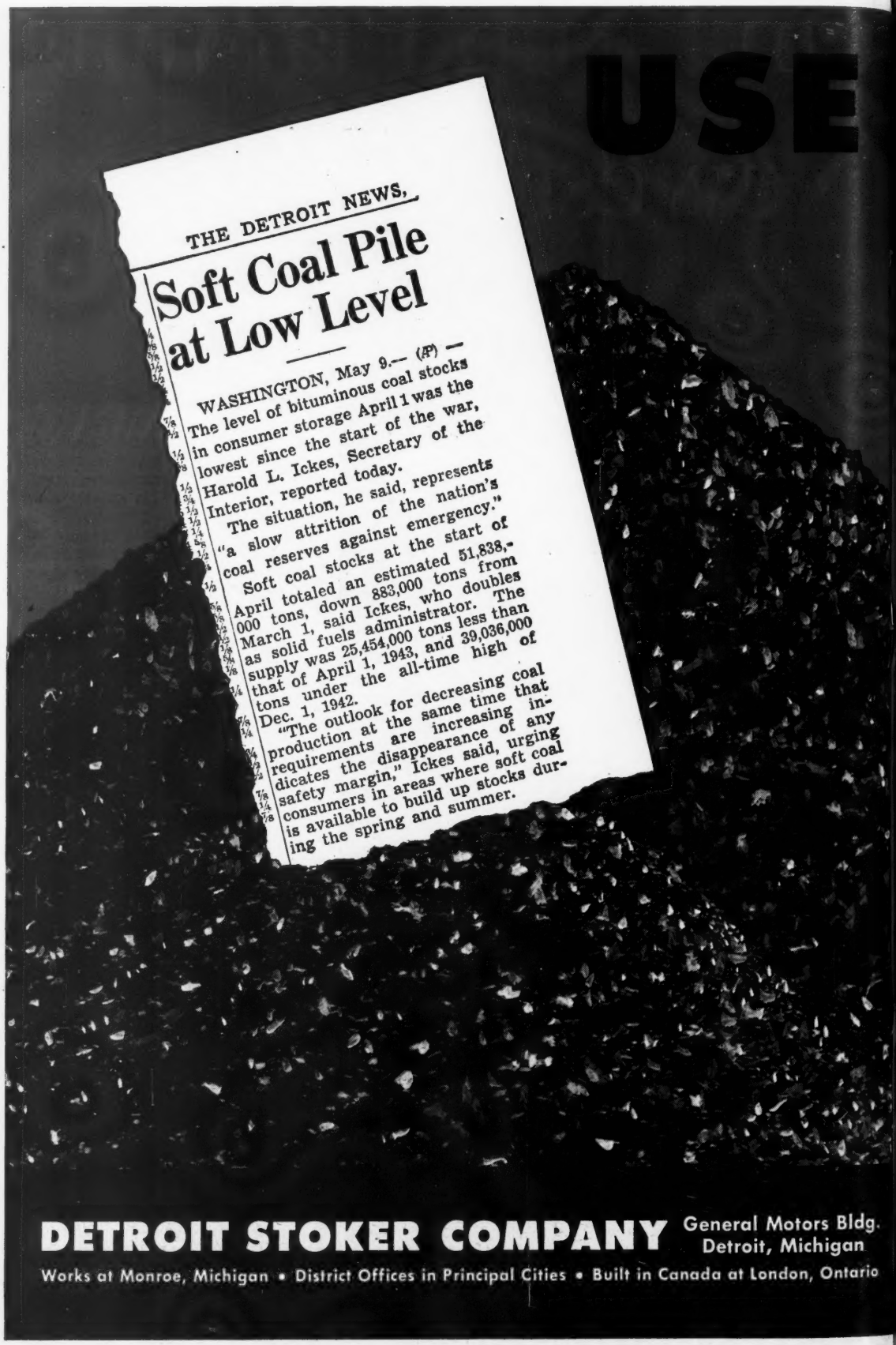
ALLIS-CHALMERS, MILWAUKEE 1, WIS.

• • •

A 1746

E YOUR UNIT SUB IDEAS WORKED OUT WITH

S CHALMERS *"Unit Sub Builder" Set*


USE
THE DETROIT NEWS,
Soft Coal Pile at Low Level
WASHINGTON, May 9.— (AP) —
The level of bituminous coal stocks in consumer storage April 1 was the lowest since the start of the war, Harold L. Ickes, Secretary of the Interior, reported today.
The situation, he said, represents "a slow attrition of the nation's coal reserves against emergency."
Soft coal stocks at the start of April totaled an estimated 51,838,000 tons, down 883,000 tons from March 1, said Ickes, who doubles as solid fuels administrator. The supply was 25,454,000 tons less than that of April 1, 1943, and 39,036,000 tons under the all-time high of Dec. 1, 1942.
"The outlook for decreasing coal production at the same time that requirements are increasing indicates the disappearance of any safety margin," Ickes said, urging consumers in areas where soft coal is available to build up stocks during the spring and summer.
DETROIT STOKER COMPANY
General Motors Bldg.
Detroit, Michigan
Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

LESS COAL

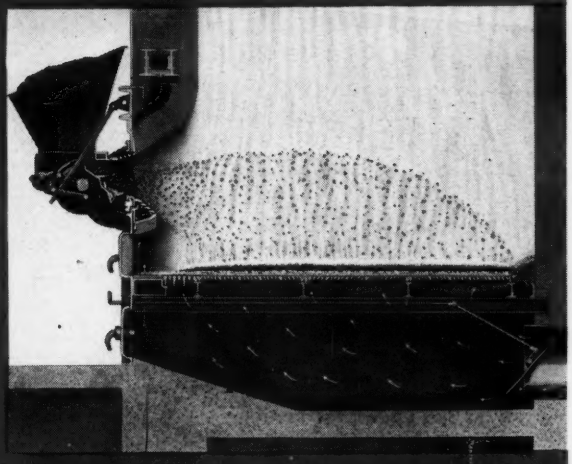
DETROIT STOKERS

• burn a wide variety of coals —make substantial savings

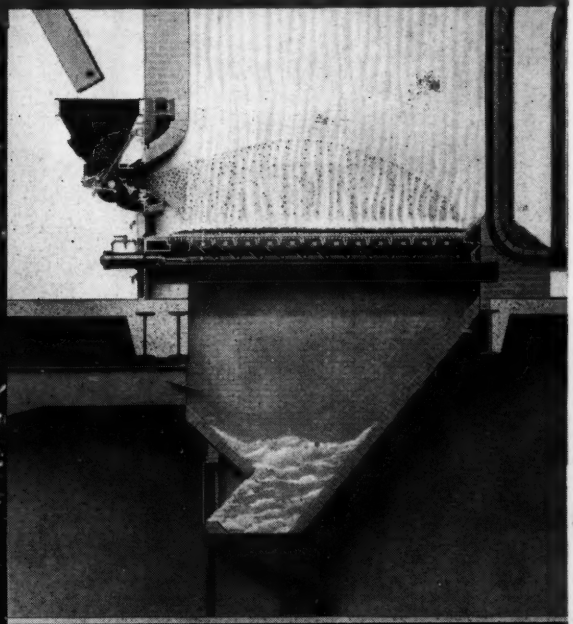
The Nation's coal stocks are low —lowest since the beginning of the war, according to the Department of the Interior. Coal men estimate that the Nation must burn much less coal next winter.

Detroit Stokers make substantial savings, particularly on fluctuating loads. They permit a wide choice of fuel—important if transportation difficulties make it necessary to change coal frequently.

Detroit Stokers require no special fuel preparation. Write for literature.

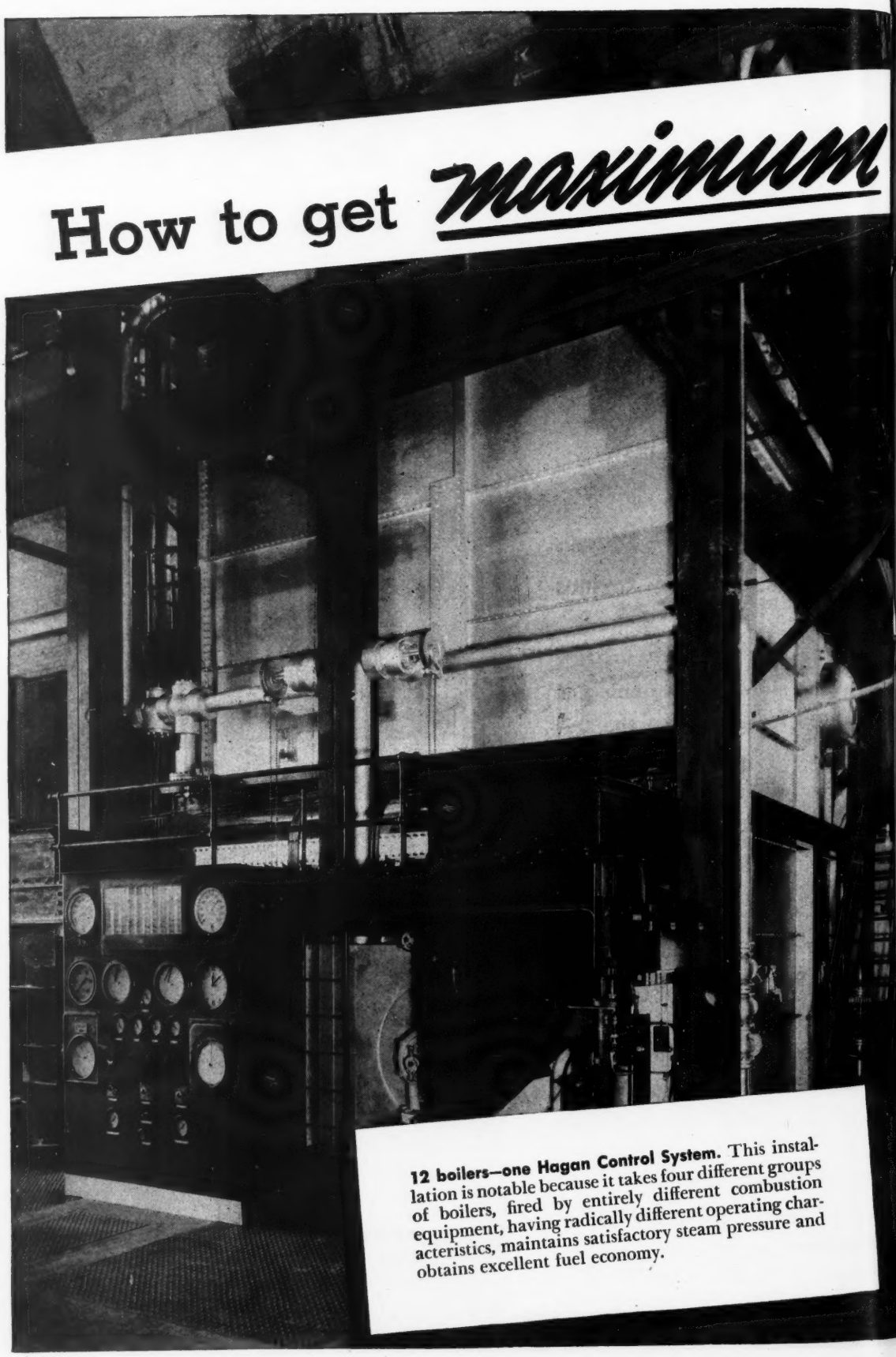


Detroit RotoStoker (Stationary Grate Type) for medium boilers. OVERTHROW ROTOR ACTION assures uniform fuel distribution.



Detroit RotoStoker (Power Dumping Grate Type) for larger boilers. Burn fine particles of fuel in suspension—coarse coal on grates.

How to get *maximum*



12 boilers—one Hagan Control System. This installation is notable because it takes four different groups of boilers, fired by entirely different combustion equipment, having radically different operating characteristics, maintains satisfactory steam pressure and obtains excellent fuel economy.

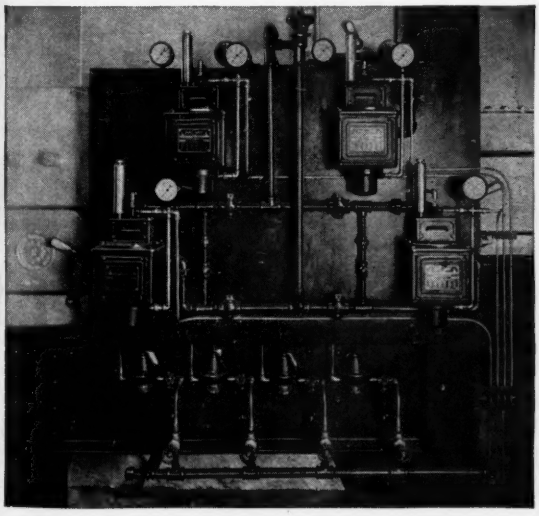
combustion efficiency

. . . and obtain highest steam output for every pound of fuel.

HAGAN Automatic Control is "made to order" for war conditions. It maintains highest efficiency with little attention from the operating staff. It gives new men a chance to learn boiler operation without wasting large quantities of fuel in the training process.

The increased efficiency you will get depends upon your present plant conditions. This much is certain. Hagan Control, by keeping all auxiliaries regulated for the highest efficiency, *will obtain maximum steam from every pound of fuel you burn.*

This Hagan efficiency is directly due to superior engineering and exclusive Hagan features. It began 26 years ago when Hagan was first to recognize the need for incremental control—that is, a control that would operate in accordance with the demand for steam. It followed step by step in this lead, coming out *first* with practically every notable improvement. It *is* first in the field today. **Get the facts** about it.



87.3% overall operating efficiency was obtained by this Hagan Control in a medium-sized power plant. The station is under continuous operation and burns mid-western coal.

HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM UTILIZATION value, uniform steam pressure in accordance with demand.

MAXIMUM OUTPUT from boilers of different capacities, automatically.

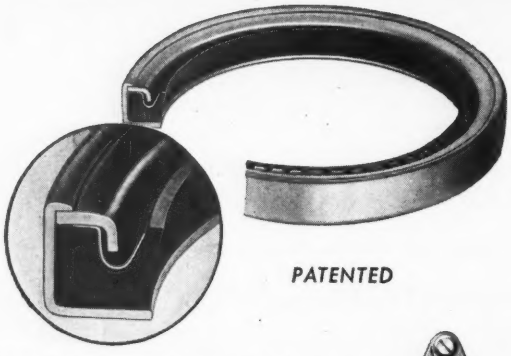
MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader



PATENTED

THE GARLOCK KLOZURE Oil Seal resists oil and water at high or low temperatures. Stays firm; stands up under severe conditions without losing its toughness, density or resiliency.

On Every Front

GARLOCK Packings, Gaskets and KLOZURE Oil Seals are helping to keep production running at top speed in war plants and essential civilian industries on the home front. Also they are giving dependable service on our many battle fronts—on warships, landing barges, tanks, bombers and fighter planes—for a quicker end to this war of aggression.

THE GARLOCK PACKING CO., PALMYRA, N. Y.

In Canada: The Garlock Packing Co. of Canada Ltd., Montreal, Que.

GARLOCK

A Compact Power Supply Right Where It's Wanted

Close to the load, yet out of the way

- ✓ NO OIL
- ✓ TOTALLY METAL ENCLOSED
- ✓ NO FIREPROOF VAULTS
- ✓ REMOTE MOUNTING UNNECESSARY
- ✓ NO LONG RUNS OF HEAVY COPPER

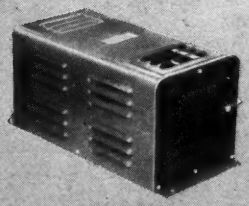
TUCKED AWAY UNDER THE EAVES at Kaiser Cargo, Inc., Shipyard No. 4, this 25-kva G-E dry-type transformer takes power from a 440-volt circuit and steps it down to operate 110- or 220-volt electric hand tools and lighting circuits, close by. The inherent safety that permitted it to be placed close to the load eliminated the need of long runs of heavy, expensive copper.

Installed right at the load, Type D transformers provide your equipment with the right voltage for its most economical operation. They are being used, profitably, from coast-to-coast in industrial plants to insulate one circuit from another and to boost or step down voltage for the most efficient operation of such equipment as motors, machine tools, welding apparatus, heat-treating furnaces, and high-current testing devices.

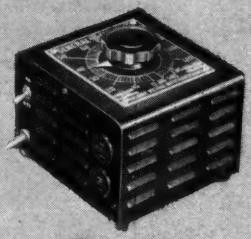
Stay cool; save space—Type D transformers are cooled by natural-draft ventilation. Their unique, drip-proof case, which incorporates a slanted-louver construction, aids the flow of ventilation air through the transformer coils. They can be placed against a wall or close to other units, with little or no effect on the temperature rise of the transformer. Because of this fact, considerable space can often be saved, especially when a number of these transformers are to be banked.

Easy to install; maintenance negligible—As these transformers are small, compact, and lightweight, they are easy to install on the floor, on the wall, or anywhere you wish. Either conduit or open wiring can be used. The ease of disassembly and reassembly of case parts permits quick inspection and cleaning, when necessary. But operating records show that little or no maintenance is required. Type D transformers are available in ratings up to 100 kva, 600 volts. For further information, ask for Bulletin GEA-897. *General Electric Company, Schenectady 5, N. Y.*

OTHER G-E AIDS TO BETTER VOLTAGE



VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters.



VARIABLE-VOLTAGE AUTO-TRANSFORMER—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment.

AIR-COOLED REGULATORS—Automatic type: for secondary circuits (10% regulation, raise and lower). Remote-motor or hand operated: for laboratory or testing (100% raise and lower). Ratings up to 12 kva, 600 volts.

THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB **BETTER**

GENERAL ELECTRIC

403-71-5205, 5400

THE DEGASIFICATION OF WATER

SINCE 1885 Cochrane engineers primarily have designed and applied equipment for the heating, degasification, and chemical treatment of boiler feed water. Naturally, in more than fifty years of such activity, problems were encountered requiring equipment to condition and degasify waters of unusual physical and chemical characteristics. For example, feed water deaerating equipment to operate at pressures ranging from sub atmospheric to over 125 lbs. per sq. in. has been designed and installed. Equipment for deaerating cold water at temperatures as low as 35 deg. F., and other equipment for removing carbon dioxide, hydrogen sulphide and ammonia have been furnished in large as well as in relatively small capacities.

The problem of removing dissolved gases from water may be quite complex, as coordinating a design and determining a guaranteed performance involves a thorough analysis of temperatures, gas pressures, viscosities, ionization, division of water and vent rates. An apparatus designed to remove oxygen to "zero content" is quite inadequate for removing a small quantity of ammonia. Likewise, a decarbonator designed to remove large quantities of carbon dioxide may not be suited to remove hydrogen sulphide.

Knowledge of these factors and their relative importance in the design of degasification apparatus is a part of Cochrane experience and is supported by tests and data from actual installations, placing us in a position to quote on equipments for degasifying water irrespective of their size.

Outstanding Cochrane equipments vary in size from 1000 lbs./hr. to 45,000,000 lbs./hr., indicating the broad coverage of Cochrane experience.

The purpose of this bulletin is to point out briefly some of the problems of degasification and to indicate generally the equipment used in the solution of these problems.

[1]

A NEW PUBLICATION YOU WILL WANT TO EXAMINE

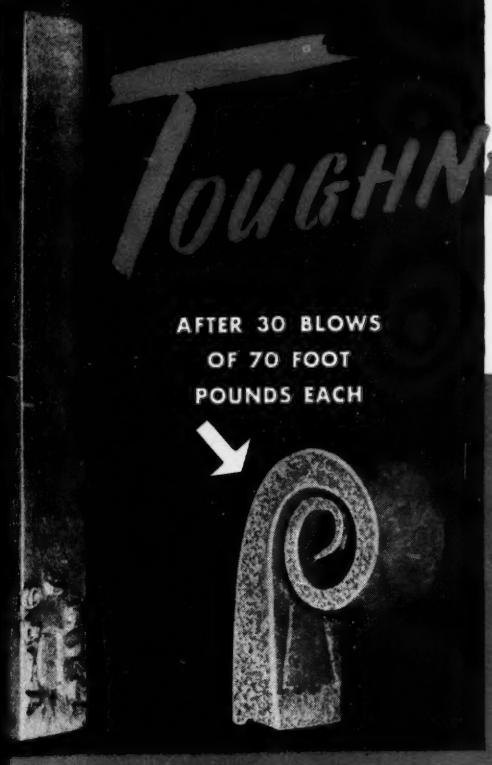
The booklet shown on the right, from which the above page is taken, describes concisely many pieces of equipment designed and manufactured by Cochrane for the removal of Ammonia, Carbon Dioxide, Hydrogen Sulphide, Oxygen and other gases from Process and Boiler Feed Water. Write for a copy mentioning any specific water problem in which you may be interested.

COCHRANE CORPORATION 3123 N. 17th St., PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

Toughness like this prevents destruction like this



-specify JENKINS AIR FURNACE MALLEABLE IRON VALVES

For the services in which valves must take unusual punishment, but where pressures and temperatures are not high enough to require steel valves, Jenkins now offers Air Furnace Malleable Iron Valves.

These new valves effect a two-way saving. Their first cost is considerably less than that of carbon steel valves, even though they compare favorably in strength and impact resistance. Also, they save by eliminating costly valve breakage and service interruptions.

Next time you order valves for use *where steam pressure does not exceed 150 pounds, and where temperature is not above 450°F.*, check service conditions closely. If the valves will be subject to destructive shocks and strains, or corrosion, specify Jenkins Air Furnace Malleable Iron Valves.

WRITE FOR BULLETIN No. 192 and specification sheets, which describe the complete line of Globe, Angle, Gate and Check patterns, sizes 2" to 6". Write to Jenkins Bros., 80 White Street, New York 13, N. Y.

Malleable Iron survives this brutal test without fracturing

The wedge test is convincing proof of the toughness and shock-resistance of Malleable Iron, and shows why these new Jenkins Valves stand up under valve-torturing strains. The Malleable Iron Founders Society describes the test as follows:

"The wedge used is 1" wide and tapers from ½" thickness to 1/16" in a length of 6". The specimen is tested as cast. A small drop hammer weighing 21 lbs. is dropped on the tip from a height of 3.33 ft. Each blow is equivalent to 70 ft. lbs."

COMPARE	TENSILE STRENGTH	SHOCK RESISTANCE: YIELD POINT	SHOCK RESISTANCE: ELONGATION IN 2 INCHES	TEMPERATURE LIMIT	CORROSION RESISTANCE (Relative)	VALVE COST (Relative)
ASTM 126-30 CAST IRON	34,000 LBS. PER SQ. IN.	0	0	TO 450°F		
ASTM 47-33 AIR FURN. MALL. GRADE 35018	55,000 LBS. PER SQ. IN.	35,000 LBS. PER SQ. IN.	18%	TO 450°F		
ASTM 95-36 CARBON STEEL	70,000 LBS. PER SQ. IN.	36,000 LBS. PER SQ. IN.	22%	TO 750°F		

Only top-grade Air Furnace Malleable is used for Jenkins Valves

Strongest of all types of Malleable Iron is Air Furnace Malleable. Top-rated grade is Air Furnace Standard Specification ASTM-47-33, Grade No. 35018 . . . used by Jenkins.

Meet U. S. Standards—Jenkins Air Furnace Malleable Iron Valves meet standards of U. S. Maritime Commission, and the Bureau of Marine Inspection and Navigation, U. S. Coast Guard.

High Corrosion Resistance—Air Furnace Malleable Iron Valves resist corrosion better than carbon steel or cast iron valves. This advantage, plus high impact resistance, recommends these valves for marine, petroleum, mining, and various chemical and industrial services.

Fig. 1101
Inside Screw, Bronze Mounted Gate

JENKINS VALVES

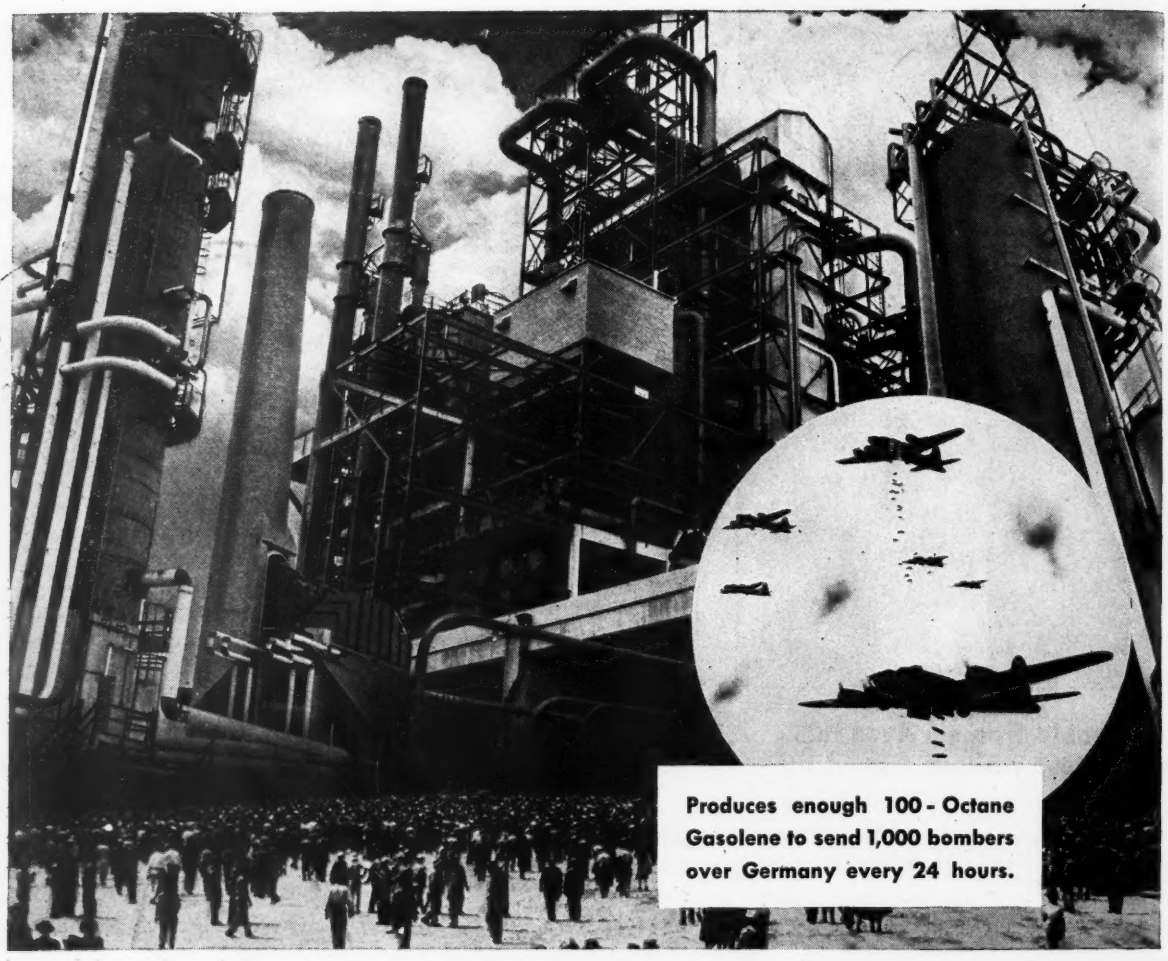
SINCE 1864

For every industrial, engineering, marine and plumbing-heating service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal, London.

TRADE JENKINS MARK

Jenkins Bros.



CITIES SERVICE

dedicates one of the world's largest 100-Octane and Butadiene Plants

WITH THIS giant plant at Lake Charles, Louisiana, Cities Service, in cooperation with the Government, takes a tremendous stride toward meeting two most vital war needs.

Sired by the necessity of War, the plant means more power to the armed forces, for it turns out great quantities of high-octane aviation gasolene and ingredients for synthetic rubber.

Created from the ground up, it includes the very latest discoveries and inventions; and it is wholly dedicated to bringing the War to an earlier close. This great accomplishment is an outstanding example of what can be achieved by the winning team of Government and Industry . . . working together, shoulder to shoulder, in the battle for Freedom and Peace.

GASOLENE POWERS THE ATTACK—*Don't waste a drop!*

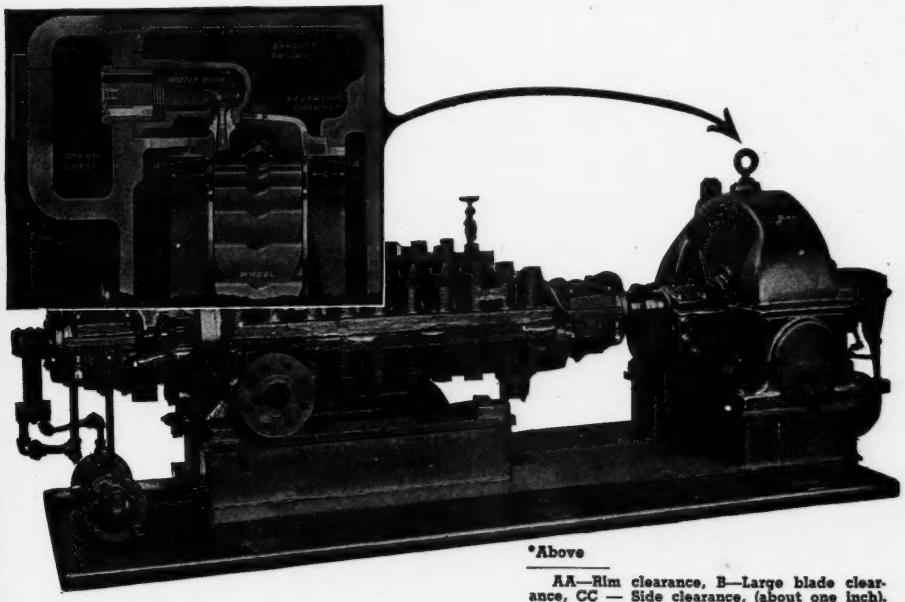
✓CHECK LIST OF OUTSTANDING FACTS . . .

1. The Refinery produces enough 100-Octane Gasolene to send 1,000 bombers over Germany every 24 hours.
2. Ten per cent of the Nation's normal rubber demands will be supplied by the Government-owned Butadiene Plant, operated by Cities Service, and the Government-owned rubber plant, operated by Firestone.
3. The Refinery alone covers 600 acres.
4. Powered by enough electricity to light a city of 250,000.
5. 275,000 gallons of water per minute are pumped into the refinery.
6. 25,000,000 man-hours went into its construction.

CITIES SERVICE OILS — ONCE-ALWAYS

FREE: Handsomely illustrated booklet about one of the War's biggest industrial achievements. Write Cities Service, Sixty Wall Tower, New York 5, N. Y.

TERRY



*Above

AA—Rim clearance, B—Large blade clearance, CC — Side clearance, (about one inch). Blades cannot foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.

END PLAY WILL NOT DAMAGE THE BLADING OF THE TERRY WHEEL TURBINE

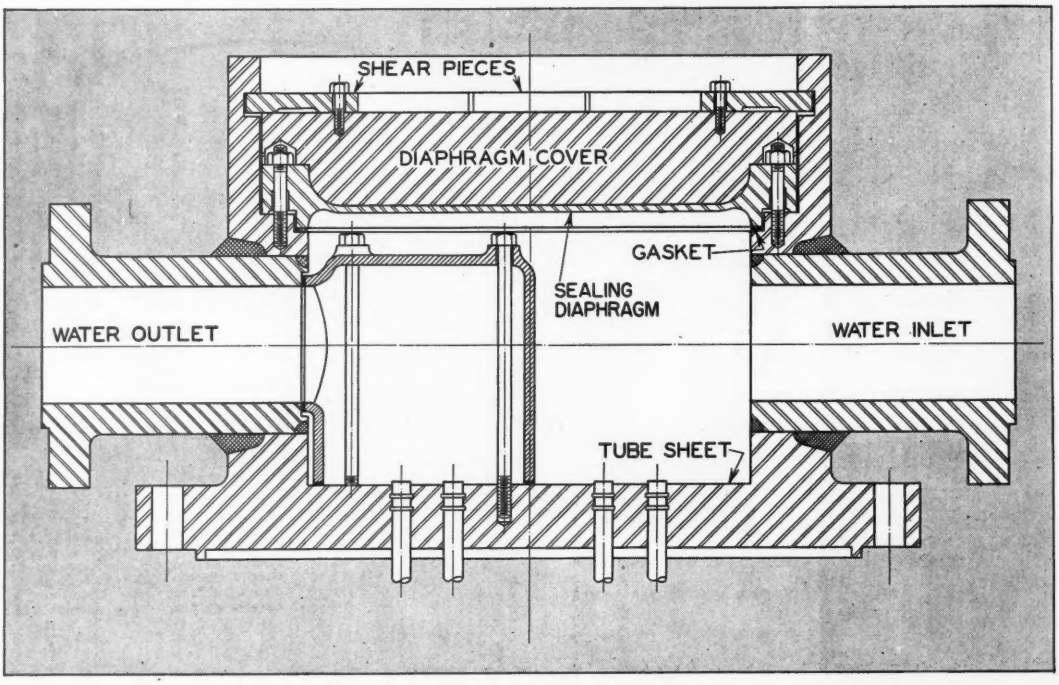
In the Terry Wheel Turbine the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced. With this construction it is impossible for the blades to foul and frequent inspection of the thrust bearing is not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1133

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Blazing THE



LOCKHEAD CLOSURE

The "Lockhead" closure, developed by Foster Wheeler in 1931, is still the simplest and most efficient design for high pressure heads. Units are operating up to 3200 lb. pressure and range in size to 10 ft. in diameter. Designs are available for conditions exceeding these limits. Unique advantages of this design are:

Foster Wheeler is a Four Star Winne under the U. S. Navy Board of Awards for produc tion.

1. Pressure load carried by cover block and shear pieces, independent of gasket load.
2. Gasket bolts are independent of pressure load and insure tight main joint regardless of pressure or temperature changes.
3. Entire tube sheet area is completely accessible on removal of cover and diaphragm.
4. Small bolts and simplicity of design facilitate dismounting—ordinary tools are sufficient.

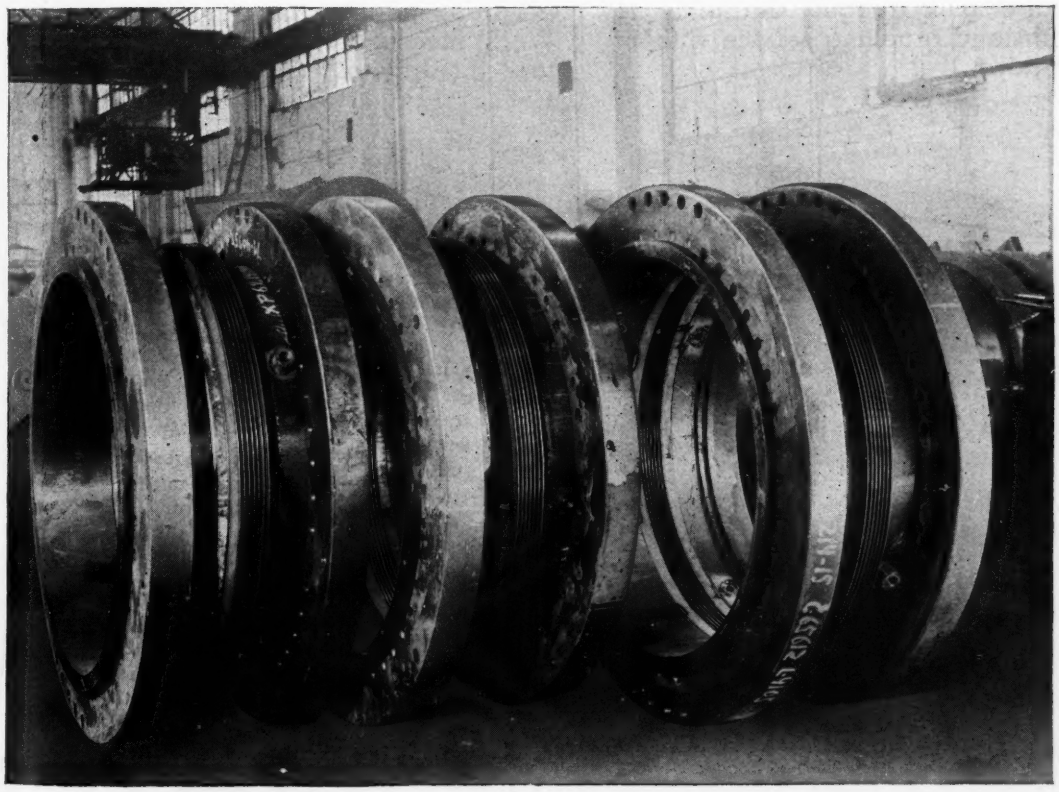
FW FOSTER

E ENGINEERING TRAIL

TYPE "S" EXPANSION JOINT

The first "S" type all-welded bellows expansion joint went into operation during 1934. Since then over 4500 of these joints have been designed and built by Foster Wheeler for all types and combination of movements, for temperatures to 1800° F. and pressures to 600 psi.

Flexibility of movement afforded by joint design and stainless steel bellows permits operation with minimum mechanical force. The assembly is electrically welded by the Foster Wheeler "Sta-Norm" process which does not alter the stainless or physical characteristics of the steel discs at any part of the bellows.



FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, N. Y.

R WHEELER FW

Two more examples of
CANTON'S *typical* SERVICE

Saving FUEL, MANPOWER AND MONEY
Stepping up EFFICIENCY AND STEAM OUTPUT

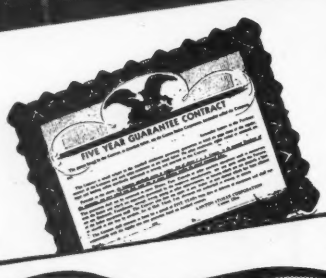
On the industrial front Canton Stokers are giving unfailing service — keeping vital power plants producing at "top" output. That's one reason why hundreds of organizations rely on Cantons — know their economy of maintenance and operation, praise their rugged durability to withstand gruelling service without let-down.

Because Canton Stokers are engineered for the toughest assignments, you can readily understand why Canton's files are filled with many case history success reports. Also why so many Canton users are repeat buyers when additional boilers need dependable stoker equipment. Worth investigating for your needs, too? Send the coupon today.

Case History
E&W Dyeing Corp. of N.J.—Paterson, N.J.

OVER 200% OF RATING EASILY— AFTER CHANGING FROM OIL TO COAL WITH CANTONS . . .

A large volume of steam is required at The E. & W. Dyeing Corporation for their processing and heating operations. With increasing demand upon the two 250 H.P. boilers formerly oil fired, the change-over to coal firing with Cantons made possible efficient operation at 200% of rating and easily met the higher demand for steam. Mr. R. Ullnick, Purchasing Agent for E. & W., reports "completely satisfactory service from the two Vulcan Ramfeed Cantons with no repairs necessary since installation." Yes, another example of Canton's dependable service and worthwhile savings.



THE ONLY STOKER
Guaranteed
5 YEARS AGAINST
DEFECTS AND WEAR

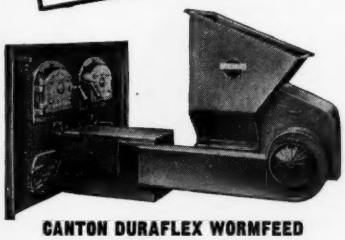
CANTON
STOKERS

CANTON STOKERS

Case History
Newburgh & South Shore Railway, Cleveland, O.

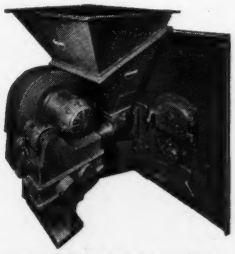
CANTON STOKER EFFICIENCY ENABLED ONE BOILER TO HANDLE FULL LOAD

Over three years ago a Canton LO-SET Ramfeed Stoker replaced another make Ramfeed Stoker under the smaller of two boilers at the Newburgh & South Shore Railway, Cleveland, Ohio, boiler house. Because of the Canton unit's ability to efficiently fire this boiler at over ratings, the entire load was easily maintained with the one boiler. When demand was further increased the second boiler's stoker equipment was removed and replaced by another Canton LO-SET Stoker which raised the total steam output to maximum. Again outstanding success with a Canton stoker led to repeat business—typical of Canton's performance everywhere.



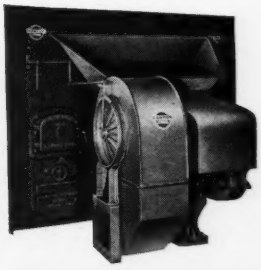
CANTON DURAFLEX WORMFEED

A side dump stoker — front fan mounting—zoned air control—especially adaptable to converting existing boilers to stoker firing.



CANTON UNIFLEX RAMFEED

Compact arrangement—front motor mounting, separate fan drive—engineered for limited space installations.



CANTON VULCAN RAMFEED

Ruggedly constructed and engineered for heaviest loads — also available in LO-SET models. Famous for carrying high overload capacities.

54 TYPES AND SIZES FOR EACH NEED UP TO 800 H.P.

Canton Ramfeed and Wormfeed Stokers are literally engineered for each specific job. You can be certain after thorough analysis of your need, that the Canton model selected will meet all requirements.

SEND TODAY FOR DESCRIPTIVE LITERATURE AND COST SAVINGS FACTS

CANTON STOKER CORPORATION

900 ANDREW PLACE, S. W., CANTON, OHIO

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

Name _____

Company _____

Address _____

City _____ State _____

*Extreme

"Tycol EP Lubricants" have proved in extensive field applications their ability to more than meet the requirements of the services for which they are recommended.

Let a Tide Water engineer help you select the proper Tycol lubricant for your needs. His familiarity with Tycol's complete line of lubricants — plus his extensive experience in all phases of industrial lubrication — is your assurance of trouble-free lubrication. Call or write your nearest Tide Water office for further information.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCO**

PRESSURE (No 2)

* This is the 12th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

TIDE WATER LUBRICANIA

DEFINITION: Extreme Pressure Lubricants are lubricants which, under certain operating conditions, permit carrying of loads greater than can be supported by mineral oils of similar viscosity.

This property of greatly increased load carrying capacity may be imparted by incorporation of suitable addition agents. The merits of EP Lubricants are defined by test and performance, rather than by chemical composition alone.

NOTE: The slight increase in load carrying ability which occurs when fatty oils are added to mineral oils is not sufficient to justify such products being termed Extreme Pressure Lubricants.

LABORATORY TEST METHODS: A number of laboratory machines are used for measuring load carrying capacity of lubricants. A series of EP Lubricants evaluated by these machines may not be rated necessarily in the same order, presumably because of differences in design and details of operation among the machines. Caution must be observed in interpreting results derived from any of these individual test methods. The degree of correlation claimed between results from laboratory measurements and those from field performance has not been positively established.

Among the more common machines employed in the laboratory to evaluate load carrying capacity of lubricants are:

The Timken Tester
The Almen Machine
The Falex Lubricant Tester
The Floyd Machine
The Four Ball Machine and
The S.A.E. Machine

At times each type of apparatus has been claimed by its proponents to be a reliable means of evaluating lubricants for a given use. No one machine is recognized generally by technologists as an exact means for predicting field performance of lubricants in all types of service. However, by using any one test machine to compare a lubricant of unknown merit with others of known service performance in a restricted field, some indication of the utility of the unknown lubricant may be secured.

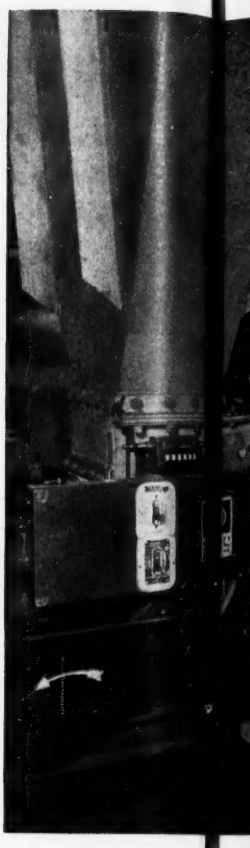
S.A.E. machine for testing EP lubricants, one of many machines used for this purpose.

Gasoline Powers the Attack — Don't Waste A Drop

INDUSTRIAL LUBRICANTS

TYCOL

CONSERVE FUEL
and lower your steam cost



Are your boilers delivering the amount of steam you are paying for—or are you being short-changed? An automatic combustion control system, as designed and built by Republic, will enable you to operate your boiler (or boilers) over long periods at *test efficiencies* regardless of variations in fuel, load and other operating factors.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual devices is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of every-day operation.

Check the following features against your list of "musts" for a perfect combustion control system.

✓ CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

✓ FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

✓ FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

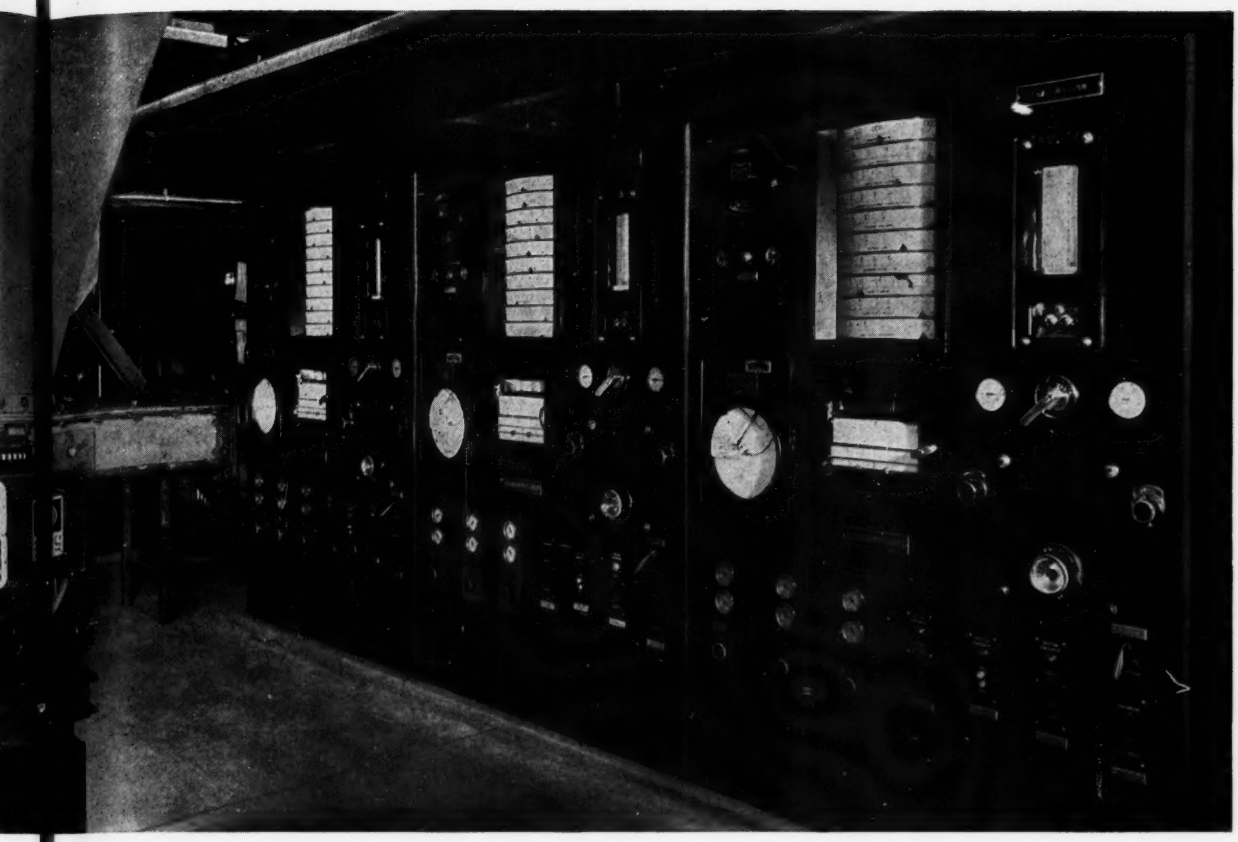
✓ ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

✓ CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

✓ LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

✓ MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

REPUBLIC
INSTRUMENTS
AND CONTROLS



PERFORMANCE FACTS

Here is a list of installation reports, available to you, which present detailed evidence of the savings derived from the installation of Republic automatic combustion control systems in typical boiler plants.

Installation Report No. 43-39
RCA MFG. CO.: 2-125,000 lb. per hr. boilers; 850 lb. pressure, 750 F; pulverized coal or oil fired.

Installation Report No. 51-40
CLINTON COTTON MILLS: 1-70,000 lb. per hr. boiler; 415 lb. pressure, 725 F; pulverized coal fired.

Installation Report No. 60-39
TIMKEN ROLLER BEARING CO.: 1-60,000 lb. per hr. boiler; 400 lb. pressure, 630 F; underfeed stoker fired.

Installation Report No. 70-39
KREY PACKING CO.: 2-35,000 lb. per hr. boilers; 330 lb. pressure; chain grate stoker fired.

Installation Report No. 31-40
SUTHERLAND PAPER CO.: 3-50,000 lb. per hr. and 2-81,000 lb. per hr. boilers; 175 lb. pressure, 450 F; spreader stoker fired.

Installation Report No. 41-40
GODCHAUX SUGARS, INC.: 1-100,000 lb. per hr. boiler; 450 lb. pressure, 560 F; natural gas fired.

Installation Report No. 61-39
WORCESTER SALT CO.: 1-125,000 lb. per hr. boiler; 200 lb. pressure, 400 F; natural gas or pulverized coal fired.

Installation Report No. 120-39
SWIFT & CO.: 2-45,000 lb. per hr. boilers; fuel oil fired.

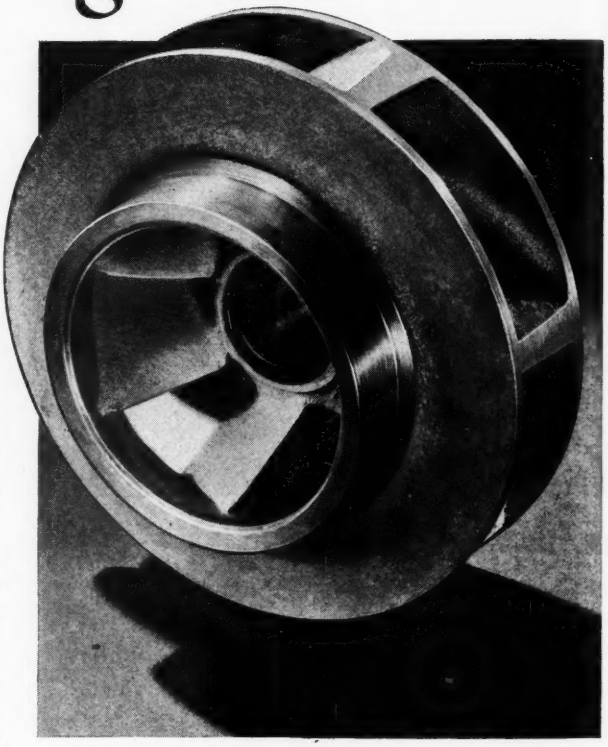
All these reports are included in Data Book No. S-21. Write for your copy today. We will gladly mail it to you without obligation.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago 47, Illinois

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make IMPELLERS Last Longer . . .



Impellers for Allis-Chalmers "Electrifugal" pumps are supplied in bronze, stainless steel, monel metal or other materials — depending upon the *exact nature* of the liquid to be pumped.

CLEARANCES between moving and stationary parts in a centrifugal pump are very small. And when pump and its driving motor are not correctly aligned or weight of piping puts undue strain on casing, every revolution of the shaft throws tremendous extra load and extra wear on all moving parts.

In the case of pumps designed with wearing rings which are attached to the casing, misalignment causes greatly accelerated wear on both rings and impeller — reducing the effective life of both.

In an effort to eliminate the misalignment problem, A-C engineers developed, for many applications, the "Electrifugal" pump — in which *both* impeller and motor are mounted on *one* shaft and in *one* frame. In such a pump the elements cannot get out of line. Result: wear on all moving parts is greatly reduced.

Besides misalignment, there are still other factors contributing to impeller wear. Regardless of type of pumps you have, here are a few tips which can help you get longer life out of impellers . . .

▸ An often overlooked cause of impeller wear is cavitation. For if pump capacity, speed, head and suction lift aren't figured properly, cavitation can eat an impeller away fast. Here's what happens: Rapid movement of impeller blade through liquid produces a cavity behind blade; local high pressure increase drives liquid into metal with terrific force! Moral: Be sure head is right for your pump.

▸ If foreign matter is being sucked into your pump it can clog or wear impeller unduly. Where this condition exists, provide the intake end of suction piping with a suitable screen.

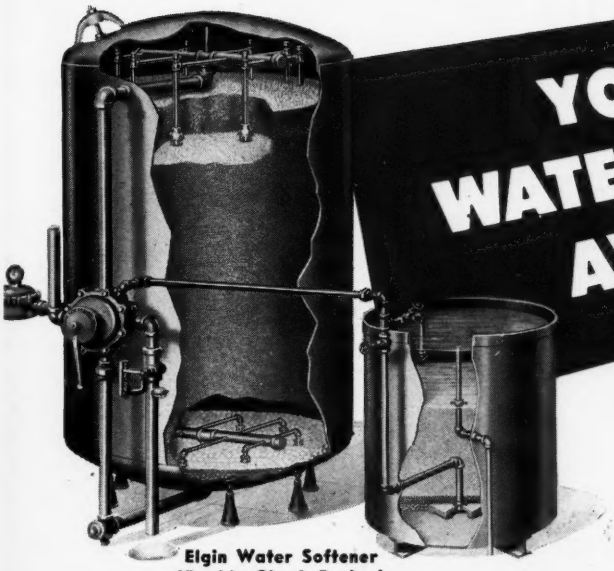
▸ When you dismantle your pumps (at least once a year), inspect impellers. If they are damaged or blade sections are corroded replace them, but *first* make a thorough search into the possible *causes* for the condition.

▸ If you haven't already done so, send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". This valuable booklet is packed with worthwhile information. Applies to *all* makes of pumps; contains *no* advertising. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1688

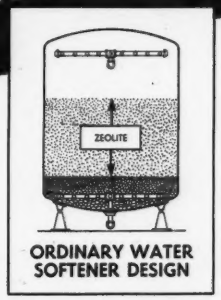
ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.

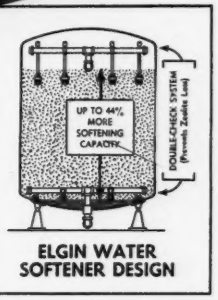
YOUR POSTWAR WATER SOFTENER IS AVAILABLE NOW



Elgin Water Softener
(Double Check Design)



ORDINARY WATER SOFTENER DESIGN



ELGIN WATER SOFTENER DESIGN

The New Elgin Water Softener

- **GIVES UP TO 44% MORE SOFT WATER**
- **CUTS SALT CONSUMPTION**
- **PREVENTS LOSS OF ZEOLITE**
- **ASSURES BETTER BACKWASHING**

WHEN it comes to zeolite water softener equipment you don't have to take the "wait-for-something-better-after-the-war" attitude. That something better is here—and is *available now.* It's the new "Double Check" design water softener. A long list of users fully confirm the fact that this water softener gives 44% more soft water than can be secured from any other unit of equal size.

One of the chief reasons for this increased capacity is diagramed above. The new "Double Check" manifold arrangement permits placing a far greater amount of water softening zeolite in the softener, as shown. More zeolite means more soft water output, for after all, it's the zeolite that softens water. This ingenious manifold also permits the zeolite to be washed cleaner and prevents packing and channeling of the bed. Brine reaches every portion of the zeolite, giving complete, efficient regeneration with lower salt consumption. All this is accomplished without the possibility of zeolite loss. Here truly is tomorrow's water softener today.

The whole story is told in our new bulletin 603. *Write for it today.*

HERE'S HOW TO STEP UP THE CAPACITY OF YOUR PRESENT WATER SOFTENER

The "Double Check" manifold arrangement can be quickly installed in place of the ordinary manifold in your present water softener regardless of make. This, along with Elgin High-Capacity Zeolite, will give you greatly increased soft water output. The cost of such modernization is surprisingly low. Ask for facts.

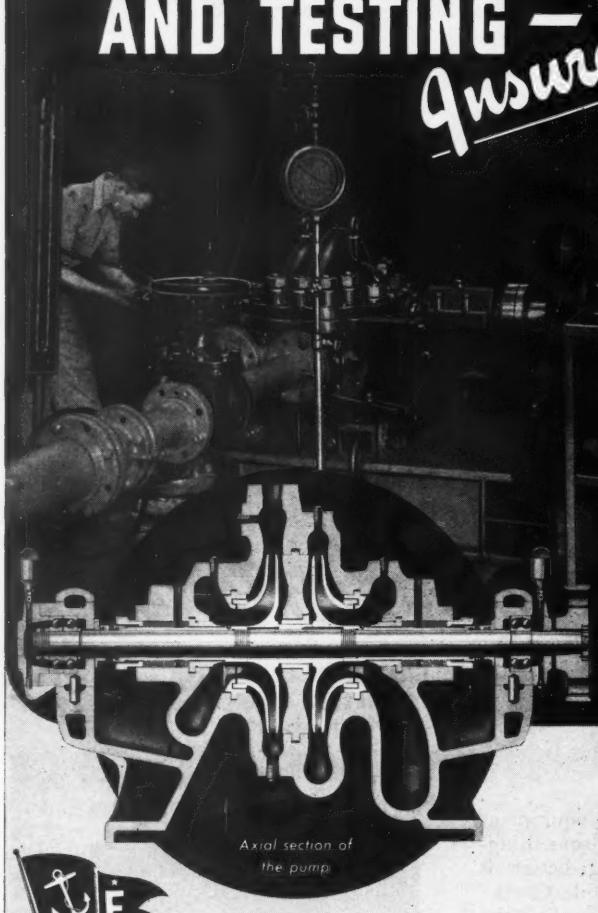
ELGIN

THE COMPLETE ELGIN LINE—Boiler Water Treating and Purifying Systems ● Feedwater Treatment ● Deconcentrators ● Heat Exchangers ● Water Softeners ● Filters and Purifiers ● Iron Removal Equipment ● Aerators ● Water Treating Chemicals ● Chemical Feeders ● Scale and Corrosion Inhibitors ● Sample Coolers ● Water Testing Equipment ● Zeolites

ELGIN SOFTENER CORPORATION, 136 North Grove Ave., Elgin, Illinois

RIGID INSPECTION AND TESTING — Insure High Quality

Opposed impeller centrifugal pump on test



Axial section of the pump

The highest quality of engineering design and of workmanship has always been the ideal of the De Laval Steam Turbine Company. High grade machines can be produced only by care in selecting and purchasing materials and by the use of specialized equipment, including precision tools, gages, jigs and measuring devices, followed by limit-gage inspection of finished surfaces and by thorough testing of completed units.

The testing here shown of a two-stage De Laval Pump is typical of the routine testing of De Laval centrifugal pumps. The pump is driven by a calibrated motor and accurate readings are made of speed, pressure, delivery and power consumption over the working range. The unit is then dismantled and all working surfaces are again inspected and checked. In some cases a torsion meter is used for determining input.

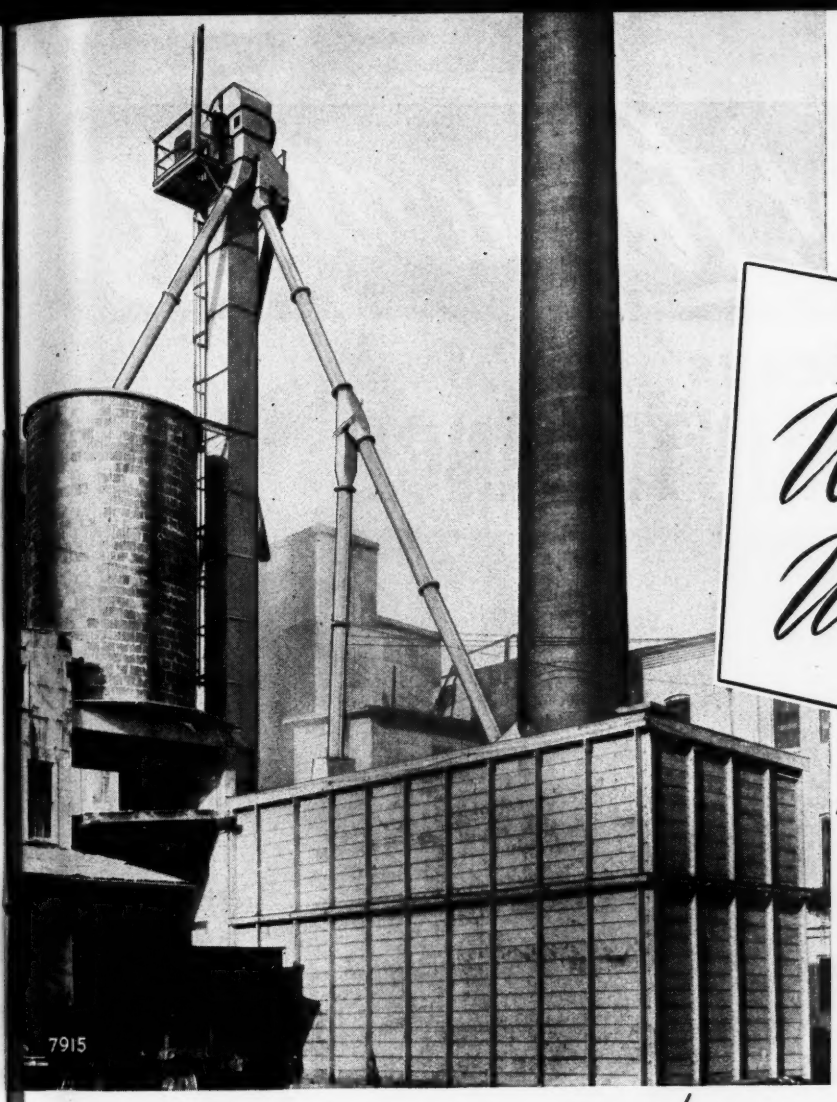
A similar procedure is followed with De Laval steam turbines, helical and worm gears, centrifugal compressors, and rotary displacement oil pumps.

The testing equipment includes suitable gages and meters for measuring power and fluids of all kinds and at various pressures and temperatures, also plant for generating steam at high pressure and temperature and for producing high vacuum.

M-34

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF TURBINES . . STEAM, HYDRAULIC PUMPS . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER, PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . WORM, HELICAL and FLEXIBLE COUPLINGS



PUTS COAL
Where YOU WANT IT
When YOU NEED IT

S-A Bucket Elevator with encaged safety ladder and drive platform. Buckets elevate coal from track hopper to storage silo at left, or to bulk storage crib shown at right.

Low Cost Coal and Ash Handling Assured by S-A Conveying, Elevating Systems

Coal and Ash Handling problems would be much more simple if there were a "standard" handling system which any plant could apply.

However, each plant has its *individual* handling problems for both coal and ash and it is in the solution of such widely differing problems that S-A specializes.

The reasons for S-A's success in this field are threefold: (1) S-A manufactures a *complete* line of conveyors, elevators, feeders, crushers and transmission equipment. (2) Experienced S-A engineers have the vital "Know-How" of combining equipment into efficient economical handling systems. (3) S-A's 43 years of experience have been devoted exclusively to the development of better material handling methods and equipment.

Write us for assistance when planning new or improved handling systems.

STEPHEN S-A ADAMSON MFG. CO.

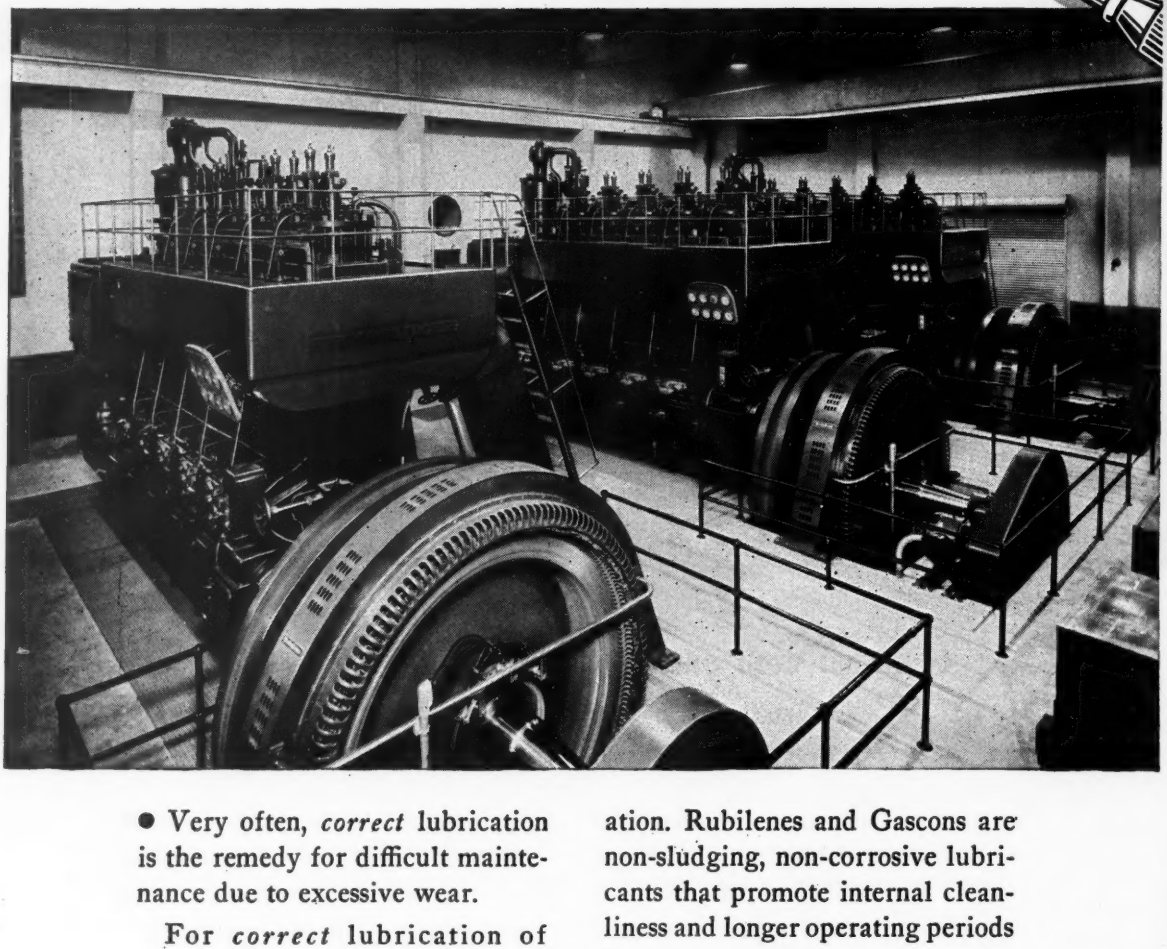
515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

Correct Lubrication

MEANS

BETTER MAINTENANCE



• Very often, *correct* lubrication is the remedy for difficult maintenance due to excessive wear.

For *correct* lubrication of *DIESEL ENGINES,* Sinclair provides Rubilene and Gascon Oils designed for wear-prevention under continuous heavy duty operation. Rubilenes and Gascons are non-sludging, non-corrosive lubricants that promote internal cleanliness and longer operating periods between overhauls.

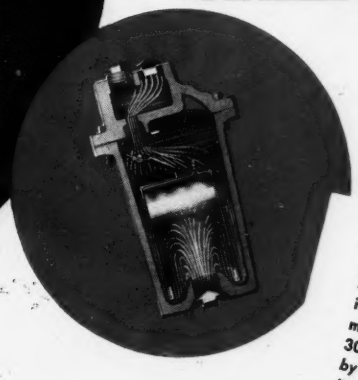
• • •

(Write for "The Service Factor"—published periodically and devoted to the solution of lubricating problems.)

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

if your traps were made of GLASS



. . . you'd see the difference

If you could look into steam traps and watch them operate you'd quickly see why so many plants are 100% Armstrong trapped. Armstrong built a trap with a glass body for exhibit purposes and many engineers have seen it work. They have seen that when steam enters the trap, the bucket floats and closes the valve absolutely steam tight. They have seen when condensate enters the trap the bucket sinks and opens the discharge valve. They have seen how particles of dirt and scale are swirled right through the trap without causing it to clog or stick or become inoperative. They have seen air bubble up through the bucket vent to collect at the top of the trap where it will be discharged when the valve opens.

They have seen the simplicity and quality of a trap that saves steam, increases machine temperatures and stays on the job. If you want to look into steam traps, write today for the Armstrong Steam Trap Book—36 pages of data, prices, capacity charts, tables and information on trouble shooting, trap installation practice, etc.

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

ARMSTRONG

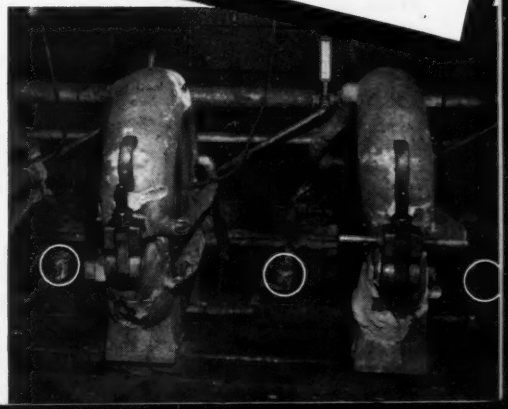
INVERTED BUCKET STEAM TRAPS

More Than a Million in Use! • *Sold through leading distributors and jobbers everywhere.*

• **CUTS FUEL COSTS 35%.** (File 4-43) Peerless Laundry Services, Ltd., Los Angeles, California, reduced fuel consumption approximately 35%, reduced heating up time by 30 minutes and reduced maintenance 8% by simply installing Armstrong Unit Trapping. (Normal boiler load is 30,000 lbs. per hour.)

• **HEATING UP TIME REDUCED 20%.** (File 1-43) When the boys in the production line want to get a machine going they don't like to stand around all day waiting for it to heat up. At Toronto Container Gair Company, Toronto, they solved this with 30 Armstrong Traps that reduced heating up time on a corrugator by 20%. P. S. Temperatures were more even and back pressure was reduced.

• **ANNUAL REPAIR COST $0.006 PER TRAP.** (File 4-41) After five years service at the Blind Floral Company, Pittsburgh, the repair cost on 165 Armstrong Traps had totaled fifty cents! You might not do as well, but this record needs no apologies even if the traps were handled with kid gloves and fed vitamins.



Horsepower and Horse Sense *Go together*

"On my seventeenth birthday, George, I got a wood turning lathe for Christmas. Well, sir; I was fascinated by all the curlycues I could turn out and, for some time, everything I made was jam-packed with curves, grooves, flutes and spirals."

"I did the same thing with a jig saw, Boss."

"Sure—but sooner or later experience and horse sense tells you that simplicity in design is the big thing, whether it's in art, architecture or machinery. These engines have given Busch-Sulzer a great reputation, because of the way they perform—and the secret of their performance is simplicity."

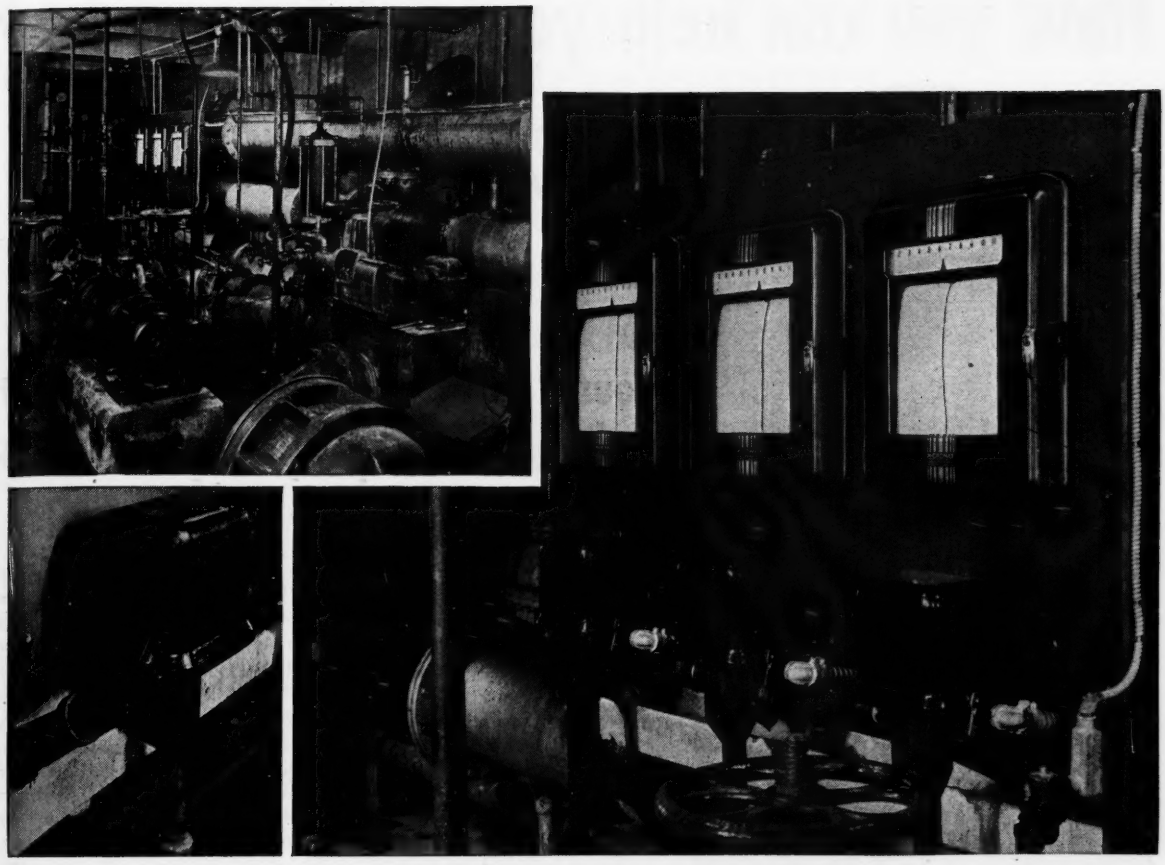
* * *

Busch-Sulzer's constant striving for simplicity is best demonstrated in its perfection of a design for trunk pistons in the larger Diesels more than a dozen years ago. Thus, the many parts of the crosshead type are no longer necessary. The innovation was greeted with skepticism, but years of performance have proved the wisdom of the change. We build Diesels for marine and stationary use in both 2-cycle and 4-cycle types. Horsepower per unit up to 7500. An inquiry on your letterhead will receive prompt attention.

BUSCH-SULZER
ST. LOUIS

BUSCH-SULZER BROS.–DIESEL ENGINE COMPANY • SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES



Typical views in the filter plant, Finishing Division of Arkwright Corp., Fall River, Mass. The three Micromax Recorders show, left to right, the pH of finished water at the clear well; pH of raw water coming into filter plant; pH of water just after alum and filters. Note electrode unit at left.

FOR HELP IN WATER CONDITIONING

Micromax Solves Arkwright's pH Recording Problem

Efficiency of water-treatment in the Arkwright Finishing Division has been considerably improved because of the complete, quick and accurate pH information which the filter plant operators get from the three Micromax pH Recorders shown above. Starting with raw water which varies from 5 to 9 pH, and treating it to a value slightly above 7, the plant had for years done a good job, but never before did it operate so easily and efficiently as since 1942, when the Micromax Recorders were installed.

Instruments selected by Arkwright for this service are our Strip-Chart Signalling Recorders; these are self-standardizing and fully automatic; they operate alarms if pH exceeds preset limits; they can be equipped at any time to handle automatic-control problems. They record in great detail, and their range is 2—12 pH, which gives ample working space on both sides of any pH value normally held in an industrial application.

The electrodes employed are our modern, flow-type glass and calomel units, sturdily made and securely housed in the metal boxes shown below the Recorders. They receive water by pipe and discharge into the trough for return to the mill's raw-water supply.

Different conditions from those at the Arkwright plant might of course call for different pH equipment, a Round-Chart Micromax, perhaps, and a different type of glass electrode. If you have a pH recording problem and will outline it, an L&N engineer will be glad to help select, from the various types of L&N equipment, that which will meet your needs.

Jrl Ad N-96-701(2)

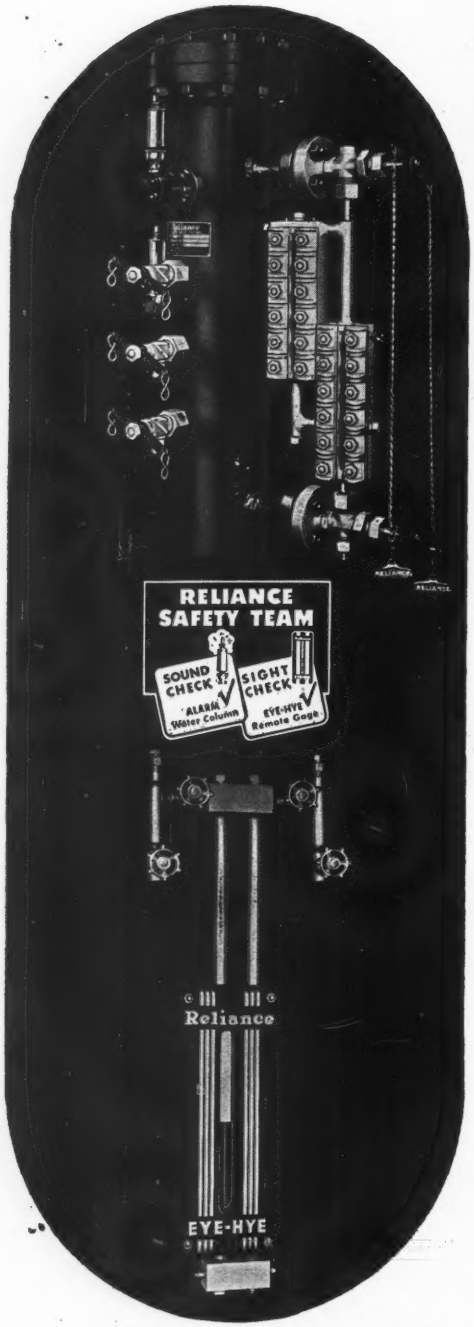
depends on me!
A Slogan For Every American

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

How you can help yourself to *Better Water Level Supervision*



Your Reliance Boiler Safety Equipment and observance of simple precautions prevent water level accident worry

IT ISN'T EASY for Reliance, like many other manufacturers these days, to supply new equipment to industry. Most of our production of water columns and accessories goes to do important jobs on boilers in armed service outposts all over the world; marine water gages for war and cargo vessels take further toll of production time. That's why it takes a little longer to deliver certain items for industrial installations.

But you can help yourself to better water supervision by taking 3 easy steps. First, survey your present equipment and put it in the best condition possible. Secondly, place orders now for repair parts or minor additions needed to maintain present equipment at its best. These parts are available from stock on your MRO priority. Third, plan now any major change or addition needed to provide perfect water level supervision. Consultation with our district service representative may enable you to select the very best arrangement and plan its future delivery for convenient installation. • • •

When you specify a Boiler Water Column, demand:

- Design, material and welding to meet ASME Code requirements
- Water level alarms sensitive to ¼" water level movement
- Dimensional size to meet the individual needs of your boiler
- Water gage vertical, inclined, or periscope vision, as you wish
- Construction and workmanship such that maintenance will be absolute minimum

When you specify a Remote Reading Water Level Indicator, demand:

- Hydrostatic operation to eliminate all mechanical working parts
- Use only one indicating fluid, which must not mix or react with water
- Factory calibration for your specific application, eliminating possibility of tampering in service
- Positive and reliable accuracy of water level reading
- Similarity of appearance to conventional boiler gage glass, for easy comparison

Only Reliance can meet ALL your requirements!

The Reliance Gauge Column Co. • 5902 Carnegie Ave., Cleveland 3, Ohio

60 Years of Boiler Protection

BOILER SAFETY DEVICES since 1884

Reliance

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

SELECTING CONDENSER TUBING For Retubing and New Construction

Power plant engineers who have been nursing their condenser tubes beyond their normal usage will welcome the easing of government restrictions on condenser tubes. Every standard alloy (with the exception of cupro nickel, which is still limited) is now available for power plant and marine use. In addition, condenser tube manufacturing capacity is also now available. However, orders for condenser tubing should be placed well in advance of actual requirements because of inevitable delays in the allocation of raw materials, processing, etc.

Much data has been accumulated on condenser tubes operating under forced wartime conditions that should prove helpful when selecting new tubes for long, satisfactory life. Those engineers who have planned ahead and who have been testing experimental lots of condenser tubing in various alloys are most fortunate because they know definitely the limitations of each alloy tried out under existing operating conditions. Those who do not have this data are invited to avail themselves of Bridgeport's laboratory service for considerable help in this direction.

Which Condenser Tube Alloy Will Give the Best Service?

With better processing equipment and the benefit derived from consistent laboratory research on corrosion, better quality, and wider choice of condenser tube alloys can be obtained. It requires both good judgment and experience to select the correct alloy for a particular installation because no two operating conditions are exactly alike.

If a certain alloy has been giving satisfactory service, and conditions have not changed, there is no good reason for using a different condenser tube alloy. On the other hand, if an installation is not standing up, and a change of alloy is indicated, a careful study of the circulating water, operating procedure, type and intensity of corrosion on representative full length tubes should be made. The characteristics of each available alloy should then be carefully studied.

To help in the selection of a new condenser tube alloy, we are briefly listing the characteristics of standard Bridgeport alloys. For more complete engineering data, corrosion studies, and specifications, we suggest that you write for a copy of Bridgeport's new 112-page Condenser Tube Manual.

Standard Bridgeport Alloys

DURONZE IV is considered one of the finest alloys made. Resists general corrosion and impingement corrosion. Not susceptible to dezincification. Especially recommended for brackish waters and polluted harbor waters, warm tropical and sub-tropical sea water conditions where other alloys fail prematurely.

Cupro Nickel-70-30-(special restrictions except for government use.) Resists air impingement corrosion and pitting. Recommended for fast ocean going turbine propelled vessels. Withstands elevated temperatures better than brasses. Gives good service in feed water heaters, heat exchangers and evaporators. Resists season or stress corrosion cracking generally caused by the combined action of moist ammonia, oxygen and stress.

Cuzinal—Superior to Admiralty in its resistance to air impingement corrosion. Contains arsenic as an inhibitor to dezincification. Excellent for seaboard power stations and turbine driven ships.

Arsenical Admiralty—Resists dezincification. Gives satisfactory service with either fresh or salt water and water polluted by sewage unless high velocities are involved.

Muntz Metal—For good fresh water conditions such as exist at some inland power stations. Arsenical Muntz contains arsenic as a dezincification inhibitor.

Arsenical Copper—For good fresh water conditions. Has excellent heat conductivity. Used for condensers and feed water heaters for river waters.

Note: Bridgeport products are supplied in accordance with existing priority regulations.

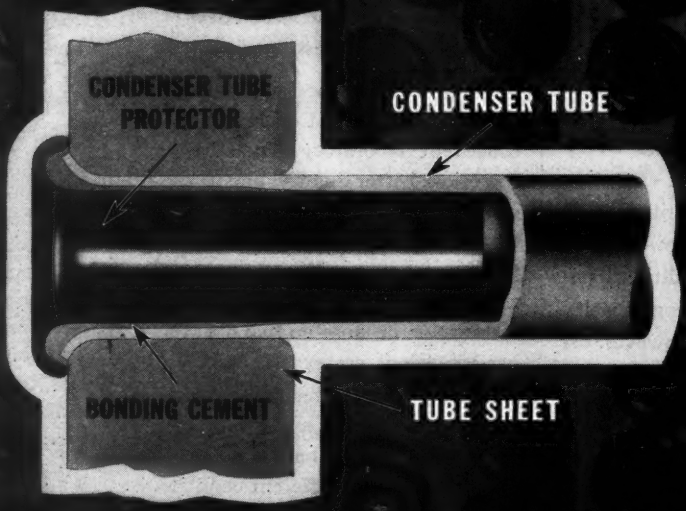
BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ESTABLISHED 1865

JOHN CRANE

Condenser Tube Protectors



ELIMINATE

Tube End Thinning - Tube End Erosion - Sand Abrasion

- Protect condenser tube inlet ends against air erosion, sand abrasion, and tube thinning.
- These *new* Condenser Tube Protectors are molded of a special wear-resistant hard bakelite material, unaffected by temperatures to 275° F.—Resistant to contaminated salt and fresh condenser circulating water and air impingement.
- Easily installed and quickly, in both old and new tubes; securely cemented in place.

NOW MANUFACTURED FOR:

5/8" 16 or 18 Gauge Tubes	7/8" 18 Gauge Tubes
3/4" 16 or 18 Gauge Tubes	1" 18 Gauge Tubes

- Increase the life of condenser tubes; save critical metals. John Crane Condenser Tube Protectors pay for themselves time and time again in longer tube life.
- For further information consult branch office nearest you.

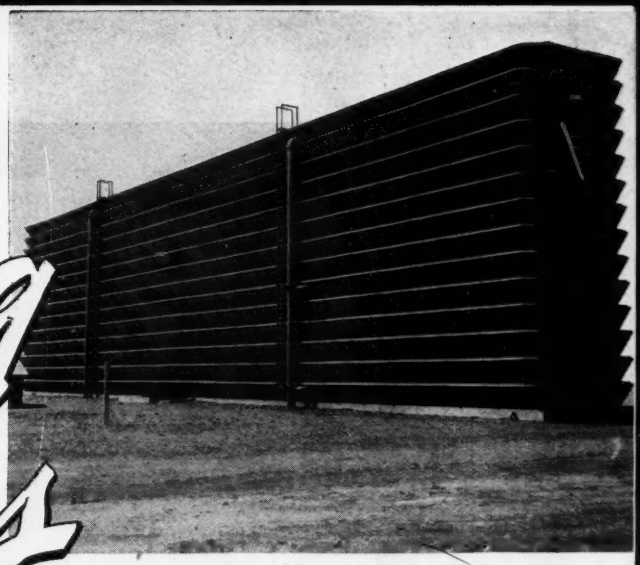
CRANE PACKING COMPANY

1812 CUYLER AVE. • CHICAGO 13, ILL.

BALTIMORE, BOSTON, BUFFALO, CLEVELAND, DALLAS, DETROIT, HOUSTON, LOS ANGELES, NEW ORLEANS, NEW YORK, PHILADELPHIA, PITTSBURGH, SAN FRANCISCO, ST. LOUIS, TULSA

CRANE PACKING CO., LTD., Hamilton, Ontario, Canada.
Branches: Montreal, Toronto, Vancouver

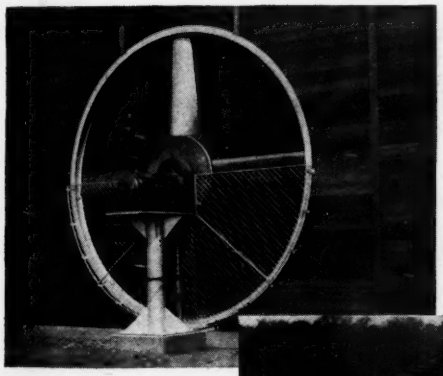
MORE ECONOMICAL AND EFFICIENT *Cooling* WITH PRITCHARD *Towers*



Pritchard Atmospheric Towers feature maximum air flow and drift control

DURING the 15 years J. F. Pritchard and Company have designed and constructed cooling towers three equally important factors have been kept in mind... Improved Cooling Efficiency... Reduced Operating Cost... and Prolonged Tower Life. The thousands of Pritchard Towers—both mechanical and atmospheric—now in operation are proof that this policy has been rigidly adhered to.

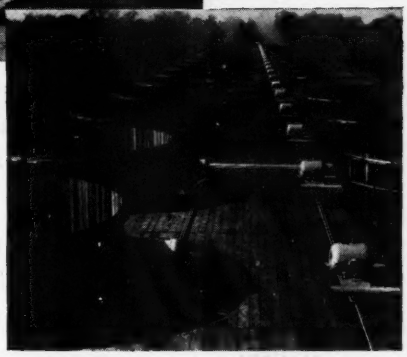
There is a Pritchard Tower for every job with the capacity to meet every load demand. Your cooling tower problem can well be placed in the hands of Pritchard engineers with the full assurance that it will receive individual study and result in a properly designed and constructed tower.



Above—One of the Non-corrosive "Featherweight" fans installed in a Pritchard forced draft mechanical tower

Atmospheric Cooling Towers are designed to give the greatest amount of air flow, contacting the water where concentration is the heaviest. Construction is such that water break-up is maximum, thus giving more actual water surface for air to pass over.

Mist extractors prevent excessive moisture loss due to drift, the trapped water being returned to circulation by means of drift retrievers. These are exclusive Pritchard features.



Right—Pritchard induced draft mechanical cooling towers offer patented protective features

Pritchard Mechanical Cooling Towers are constructed for induced draft or forced draft operation. Both are built upon the principle of counter flow, a method making for efficiency. Use of the exclusive non-corrosive "Featherweight" fans assures lower cost and longer life. J. F. Pritchard and Company, *Cooling Tower Division,* Fidelity Building, Kansas City, Missouri.

KANSAS CITY
TULSA
CHICAGO

Pritchard

HOUSTON
NEW YORK
PITTSBURGH

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

SIMPLEX

INCREASE FLOW CAPACITY 40% TO 60%

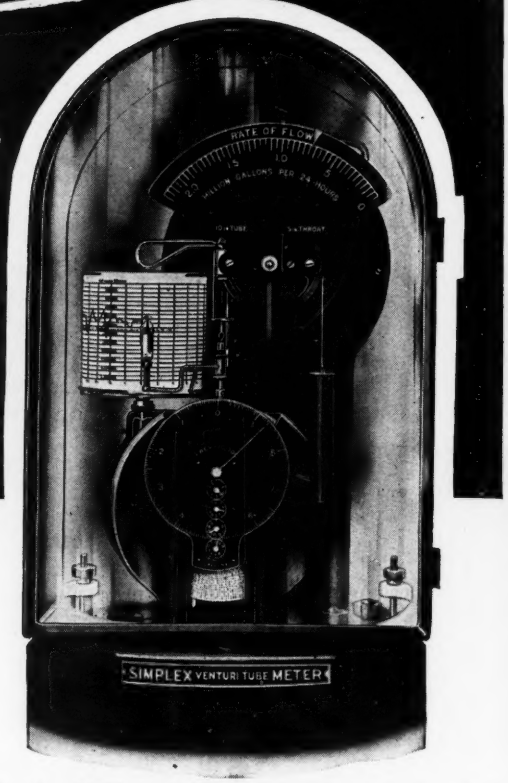
MOL or MOLA METERS

with flow ranges

FROM **20 to 1**

TO **28½ to 1**

OR TO **40 to 1**



Two typical examples of the ease and economy of increasing the maximum capacity of flow lines with the use of Simplex MOL and MOLA wide-range meters are given below:

1. **A change in operating heads enabled a large municipal water department to increase the total capacity of one of their pumps from a maximum of 60 million gallons per day to 72 million gallons per day by replacing the existing Simplex MO Meter with a Simplex MOL Meter. No change in the Venturi Tube, Pump Impeller, or motor was required, and operating costs showed a marked decrease.**

2. **By substituting an MOLA Meter for an MO Meter, increased requirements were met without any change in the Venturi tube, permitting an increase of from 13 million gallons per day to 21 million gallons per day.**

Simplex MOL and MOLA meters are designed to function over extremely wide flow ranges—and the accuracy of measurement and totalization is maintained at both maximum and minimum ends of the range.

Look into the advantages and economies of making use of Simplex instruments for performing the extraordinary as well as the conventional metering operation.

Write today; our recommendations are made without obligation.

BLUE PRINT NOW

SIMPLEX VALVE & METER COMPANY

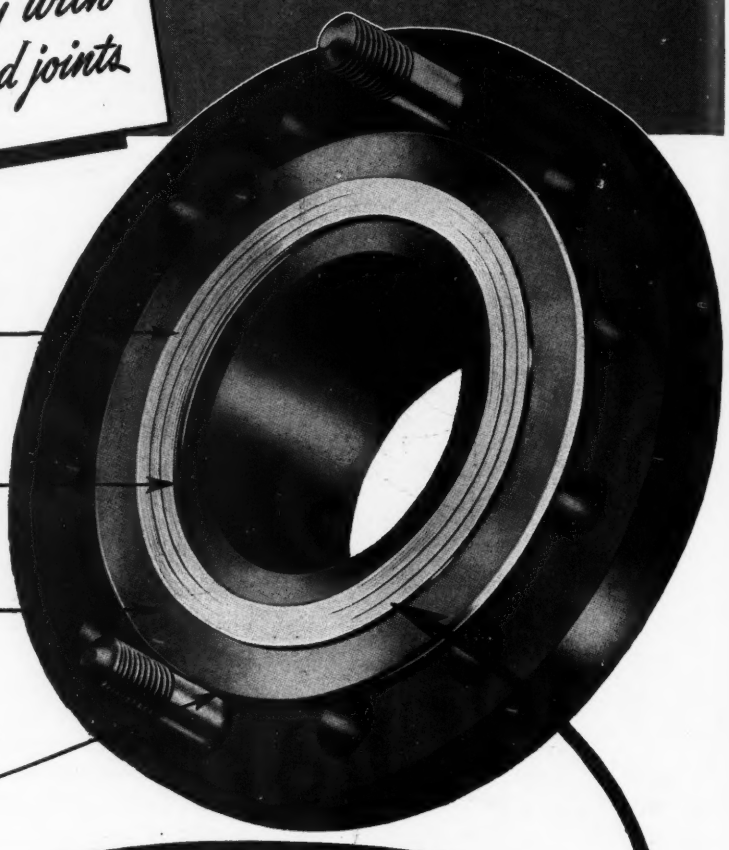
6783 UPLAND STREET, PHILADELPHIA 42, PA.

"On Location"
FOR NEW POSTWAR LOADS...
IN ONE UNIT!
Quick, low-cost reconversion . . . with
Westinghouse CSP Distribution Transformers
Going "on location" to new postwar load centers is greatly simplified with Westinghouse CSP (Completely Self Protecting) Distribution Transformers. There is no time-consuming, costly disassembly and reassembly of nine or so pieces of conventional equipment.
Every part of the CSP transformer is built-in. To move it, all that needs to be done is: disconnect . . . take to new location . . . mount . . . reconnect. Tomorrow's unpredictable loads can be handled with minimum investment in time and money.
Many CSP transformers can be moved in the time ordinarily required for a few conventional installations.
Westinghouse CSP Distribution Transformers offer maximum load adaptability for better service continuity. A signal light warns of an overload before the internal breaker trips. All the thermal overload capacity is made safely available for short-time overloads.
For complete information, call your Westinghouse office or write for DD-46-100, Westinghouse Electric & Manufacturing Company, Dept. 7-N, East Pittsburgh, Pa.
J-70428
WESTINGHOUSE CSP DISTRIBUTION TRANSFORMERS CONTAIN:
• transformer
• "De-ion" arrester
• circuit breaker for overload and short circuit protection
• grounding gap
• current limiting resistor
WESTINGHOUSE
Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE
PACKAGED POWER

KNOW these FLEXITALLIC C-G GASKETS

They'll play as big a part in peace-time piping as they play now in war

Know these technical details—they mean safety with high-pressure flanged joints

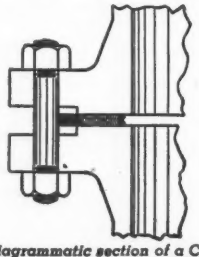


Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I. D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

Correct position assured by O. D. of gauge-ring which fits inside of bolts.



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

Note the loose fit between the active gasket member and the gauge-ring. This clearance is important. Don't let anybody sell you the idea that the fit should be snug. In a Flexitallic C-G gasket, there is always the right amount of space for the gasket to expand under compression. If the fit would be snug, the body of the gasket could move inward toward the orifice. A Flexitallic gasket moves outward to the ring. That's the right construction and no other is right.

"Flexitallic" Reg. U.S. Pat. Office

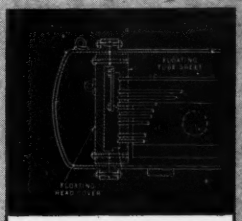
Representatives in Principal Cities

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction

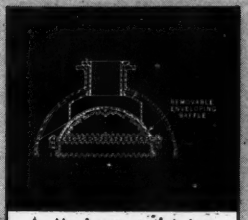
6 REASONS why G-R STAGE HEATERS assure BEST RESULTS

1. Minimum high-pressure joints . . . patented "Stationary Heads" and "U-tube" designs specially developed for high-pressure service.

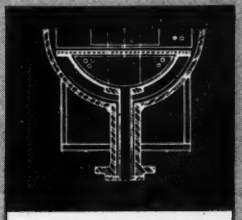


2. Joints easy to reach and keep tight without requiring handling of heavy parts.

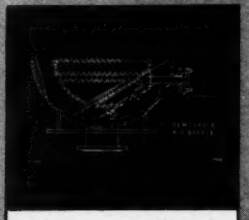
3. Internal leakage prevented . . . patented G-R partition sealing plates eliminate staybolts and prevent leakage between passes.



4. Maximum outlet temperature . . . the efficient G-R enveloping desuperheating zone is used for water temperatures exceeding the saturated steam temperature.



5. Subcooling of drains . . . before leaving the heater shell, the drains pass through the G-R subcooling zone.



6. Effective air baffling . . . provided by removable baffle.

THE ideal stage or extraction heater is one which provides greatest heating effectiveness from the available steam, together with fewest joints subjected to pressure and lasting tightness of such joints.

Griscom-Russell has been building heaters to meet these requirements for three-quarters of a century. Some of the exclusive provisions which accomplish these objectives in G-R stage heater designs for high pressure service are illustrated above. These details, together with complete description of the many types of G-R Stage Heaters, are more fully explained in Bulletin 277, which will be sent on request.

THE GRISCOM-RUSSELL CO.

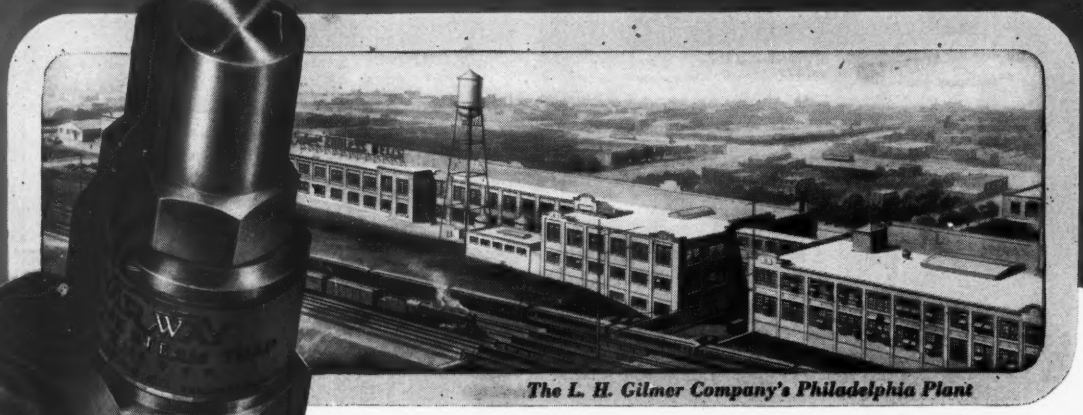
285 MADISON AVENUE **NEW YORK 17, N. Y.**

Head and cover used in the G-R high-pressure Type L "Breech Block" design of Stage Heater showing the projections which carry the hydraulic load and thereby eliminate the necessity for heavy bolts. This design has the additional advantage of an external gasketed joint which is accessible without disturbing the head cover. The cover is readily removed from the head or replaced.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

"Borrowed" Traps Did the Trick



The L. H. Gilmer Company's Philadelphia Plant

This little Yarway Impulse Trap drains the condensate from 5400 lbs of saturated steam per hour in this big vulcanizer

Yarways Solved the Problem of Draining Big Vulcanizers at L. H. Gilmer Company

Once, sluggish steam traps sabotaged the efficiency of big vulcanizing presses where those popular Gilmer Endless Belts are cured for the countless power transmission needs of Industry.

Something had to be done about it—quickly.

A Yarway Trap salesman happened to call at the plant, heard the problem, and loaned the plant engineer a few Yarway Impulse Traps and Strainers to try out on the worst trouble cases. Immediately, equipment got hotter, sooner—and stayed hotter. Yarways had "cured" the curing problem.

Needless to say, the salesman never got his traps back. They bought them and many more, and are continuing to install Yarways throughout the plant.

Solve your trapping problems by standardizing on Yarways. They not only provide *quicker heating; greater sustained heating efficiency; lower installation and maintenance cost; fuel economy* and *saving in valuable floor space;* but they often *cost less* to buy and install *than to repair an ordinary trap.*

See Your Mill Supply Dealer or write for Bulletin T-1738.

YARNALL-WARING COMPANY
114 Mermaid Ave., Phila. 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Opportunity for World Peace

By MORTIMER J. ADLER

IF I HAD to select the single most important point in my recent book How to Think About War and Peace, it would be the distinction between the *possibility* of world peace and the *probability* of its occurrence—after this war, within this century, or at a more remote time. Understanding this distinction and all that it entails is indispensable for clear thinking and prudent action as we face the problems of the post-war world. Only thus can we rightly define and estimate our opportunity to do something *now* about a possible peace whose realization is improbable in our lifetime.

We should strive to be sober idealists, aiming at the highest social good, which is world peace, without under-estimating all the difficulties in the way of its achievement. We should also strive to be enlightened realists, with our feet on the ground without having our heads there also.

To avoid the disillusionment which followed World War I, we must understand why world peace cannot be quickly instituted or maintained by the simple making of decrees—by international law, world courts, leagues of nations, or any form of cooperation among sovereign nations. To avoid the despair which results from a realistic recognition of the obstacles to world peace, we must never convert the truth that making permanent peace is difficult into the falsehood that it is impossible.

Here is the gist of the argument—first, as to the possibility of peace; second, as to its probability; and third, with regard to its practicability as an objective toward which we have, here and now, a real opportunity to work.

(1) World-wide and lasting peace is possible. The fact that throughout history there always have been wars between states is no basis for thinking that there always will be. For just as war has always occurred between states, so peace has always existed within states. Peace is nothing but the condition of men living together under the auspices of enforceable law, made and administered by effective government.

Government is the cause of local peace. It can also be the cause of world peace. The size of the community makes no difference to this principle. There is nothing in the nature of man or society which renders world government impossible. The possibility of all the separate local communities coalescing to form a single world community is the possibility of world peace.

(2) But the fact that *world government* is the minimum condition of world peace should make us realize how improbable it is that world peace will begin in our lifetime or in this century. Despite the shrinkage of social space-time, due to modern means of transport and communication, despite the growing economic interdependence of all areas of the globe as industrialism extends its influence, the political unification of the world is still remote.

Technological and economic advances make it possible for us to conceive *one world,* but the obstacles in the way of its political formation are truly formidable. A wide variety of race prejudices and all the shibboleths of political nationalism, economic imperialism and partisan patriotism, must be overcome before people everywhere will be willing to relinquish national autonomy in favor of a world federation.

(3) How, then, shall we conceive our opportunity with respect to world peace? To suppose that we can make peace at the end of this war is to hope for too much. To suppose that we can do nothing to accelerate progress toward peace is to hope for too little. We must be prepared to work for a goal which lies beyond immediate attainment, by seizing every opportunity to fight imperialism, to attenuate nationalism, to reduce race prejudice and to cultivate by education the cosmopolitan spirit in place of divisive patriotism.

By taking such steps, we shall promote world peace, hasten its coming, but we will not see it made. Our contribution to the progress of mankind is limited by the historic circumstances of the century in which we happen to be living. Our opportunity consists in taking steps which are right in their direction, though they cannot help but fall short of reaching the goal.

In his capacity as professor of the philosophy of law at the University of Chicago, Mortimer J. Adler has done a great deal of both studying and teaching in the fields of moral and political philosophy. These are the fields in which answers to all "practical" questions about details of world peace are to be found, if the human race ever finds them. Dr. Adler's thinking on this subject, which he insists must be long-range thinking, is expressed in his most recent book, How to Think About War and Peace. He is probably best known, however, for his best-seller of 1940, How to Read A Book. He is also the author of: Dialectic; Crime, Law and Social Science; What Man Has Made of Man; and a number of others. Dr. Adler was born in New York City in 1902, received his PhD in psychology from Columbia in 1929, and served as research associate at the Columbia Law School and as assistant director of the People's Institute before coming to his present post in Chicago. The above article is made available to POWER PLANT ENGINEERING through Business News Service.

Beware! Don't Buy Grand Coulee Land

Not yet—not for a number of years anyway. An aged couple recently were induced to purchase land in the Columbia Basin Reclamation Project in Eastern Washington on false pretenses. They were told that the land they purchased would be irrigated immediately after the war and that as a consequence its value would rise. The Bureau of Reclamation is anxious to nip all such attempts at land speculation in the bud. True, the Columbia Basin Project will someday become one of the finest irrigated areas in the nation but it will be many years before any of the irrigation projects are developed. Some of it may not be irrigated for 20 or 25 years. As Frank A. Banks, Regional Director of Reclamation at Coulee Dam pointed out, even though Grand Coulee Dam has been completed, a large pumping plant, reservoir dams and an elaborate system of canals must yet be built.

Anyone contemplating land purchases should be thoroughly familiar with the Columbia Basin Project Act. A new pamphlet, "Settlement in the Columbia Basin Reclamation Project" available free from the Bureau of Reclamation, explains the law in understandable language. Anyone approached to buy land in the project should write to the Bureau at Coulee Dam, Washington, to learn whether the land is actually in the project area and whether it has been classified as land that will be irrigated and what the government considers its true worth to be.

The view of Grand Coulee Dam shown above shows workmen on a barge preparing for installation of temporary trash racks on the intakes to the right powerhouse which will divert a portion of the flow of the Columbia River during maintenance of the spillway portion of the dam. Power installations have not been made in the right powerhouse but the left powerhouse is turning out 600,000,000 kwhr per month. At the same time a flock of 5000 sheep makes its way over the 550 ft high structure on their annual pilgrimage from winter feeding sheds to the forest ranges in the mountainous areas in in the north.

WITH THE EDITORS

◆ **Work to be Done**—Much practical post-war planning in the power field appears to be well under way, both for new work and for modernization. In the utility field and the larger industrials, things are in good shape, on the whole, and many plans are being made for further improvement. In the average industrial of medium and small size and in the service plants, a large amount of post-war modernization needs to be done as soon as materials and men are available for it and here too a beginning is being made in the planning.

We know, of course, that general business conditions after the war will determine how much of this work can be done. But if the present attitude of many industrialists and engineers is any indication, there is good cause for optimism. They are certainly preparing to try hard.

◆ **A few cases**—Lest anybody think we are just whistling in the dark, here are some facts gleaned by this writer during a recent swing of almost a month around the Eastern half of the country. Here and there the writer found an industrial power plant where, because of unusually high priority conditions during the war, obsolescence had been kept at a minimum. But by far the majority of industrial and utility engineers have much work that needs to be done. And the writer found only one consulting engineer out of about 30 he called on who is not extremely busy planning specific projects for specific clients. True, there is little actual construction going on now, but if that flood of blue-prints is ever released—oh, man!

A large utility has future plans for 5 topping units on various parts of its system. The first of these is now in the specification stage. Other utilities among the 85 whose projects were cancelled in 1942 by WPB are beginning to take many of them up again.

A large consulting engineering firm has no heavy construction on now, but showed the writer three single-spaced, 11-by-14 typewritten pages, devoting only a single line to each project, and merely listing the specific jobs they are working on. These include: seven different projects for a glass company; analysis of relations between processes and power development for a rubber company; analysis of power costs and rates for a utility; reports on efficiency and possible changes in certain industrial processes; design of a chemical process utilizing equipment from an ordnance works plus much new equipment; three jobs for government plants that must continue to serve the armed forces for many years; an oil refinery, complete with power plant, ready to produce refinery products; report on the present power costs of a large industrial power plant built about 8 yr ago—and so on for three pages.

Incidentally, this firm has kept all the 210 engineers who have been on its staff during the war except four; two left to go into operating work and two were discharged for cause. Its former drafting room staff, however, has been cut in half.

A few consulting engineers, for a time, co-operated with industries and equipment manufacturers in writing instruction manuals and operating instructions, for which their draftsmen and engineers were well qualified. Now those engineers are again busy with post-war plans.

An industrial power engineer is rebuilding a boiler house to meet increased load. He has revamped an entire boiler in another plant, and is planning the same in still a third. Another industrial man has specific plans for five new boilers, one in each of five separate boiler houses and in addition a complete new power plant.

In one large industrial plant, post-war production of a relatively new product now used for war but applied to exactly the same purpose in peace, will increase the steam and electric load on the power plant. The power plant equipment is modern and after proper overhauling at the end of the war, will be satisfactory. But more steam capacity will be obtained by major changes in the induced draft system and water-cooled furnace walls. These changes are being put into effect as rapidly as man-power and materials can be obtained.

That type of partial modernization project alone, if carried out in all the plants where it is applicable and necessary, would result in a tremendous flood of new work.

◆ **These are merely typical**—Everything from complete power plants to replacements of blow-off valves is actually on the boards. The clients say they want to do these things the moment the war is over—for the primary purpose of making the industrial end products better and cheaper. Most of the above does not take into account brand new industries for which existing production equipment may not serve.

If the large number of industrial and service plants that are most in need of modernization will follow the example of the leaders and make definite plans for it now, the very pressure of the possibilities will help to bring about their realization.

◆ **Information, please**—We know some people who still complain to us about how the Government didn't give them enough information and how they can't understand the things that got us mixed up in all this war mess in the first place. We always wonder what such people read in the newspapers. With all their faults—and like all publications they have some—the newspapers of the United States have, on the whole, done a perfectly magnificent job during the past ten years in reporting and interpreting the events leading up to the present war.

What happened in Ethiopia, Spain, China, Germany, Japan was all in the newspapers of the day. For people to say that all those things took place without their knowing how the various problems arose and what was behind them and what was the result of them, is the sheerest nonsense. For ten or more years, the newspapers have been filled with dispatches by such foreign correspondents as Vincent Shean, Walter Duranty, William Shirer, Leland Stowe, W. L. Stoneman, A. T. Steele, Robert J. Casey, and a host of others whose names would fill this page. Those men together with radio commentators like Murrow and Tomlinson, not only reported exactly what was happening in various parts of the world but also interpreted it as well as they could at the time and under the necessary diplomatic and military restrictions. Added to that was a perfect flood of magazine articles and books expressing opinions on what the various events might mean and what they might lead to.

For people to say that they don't know about the things that were happening before war broke out and what they meant seems to us an admission that they don't read anything except the sports pages of the newspapers.

◆ **Jet Propulsion**—General Electric's second largest wartime plant, built two years ago for the manufacture of war equipment which is no longer required by the allied forces, is being converted for the production of jet propulsion aircraft turbines.

Because of its more than 40 years' experience in the manufacture of steam turbines, and since World War I of the turbo-supercharger, General Electric was chosen by the War Department to head up the production of this new type fighting weapon. An entire plant of more than 600,000 sq ft of floor space is being converted for this work, yet its output will not be sufficient to meet government's requirements. So G-E has turned over the jet propulsion drawings and specifications, prepared by its engineers, to another large corporation formerly engaged in manufacture of airplane engines.

The jet propulsion airplane turbine, first conceived by Flight Commander Frank Whittle and built by the British Thomson-Houston Company, Ltd., an associate of G-E, was sent to this country for further development. Mr. Whittle came from England soon after, and spent three months here, but kept his identity so well concealed that few knew of his presence, even though associated with him in the G-E laboratory. A number of units have since been built, and the first of these new type planes to fly in this country was equipped with a G-E jet power plant.

The foregoing statement has been reviewed by the War Department. It contains a lot of bad news for our enemies, a lot of good news for our friends.

◆ **Hunks of Electricity**—It is strange how electron tube equipment has changed our conception of electricity. Even though we knew from theory that electricity was composed of discrete electrons we always regarded an electric current as infinitely divisible from a practical standpoint at least. Modern electronic amplifiers are so sensitive however, that unwanted fluctuations appear in the output. These irregularities cannot be eliminated because they are due to the very nature of electron emission: Electrons are freed from the cathode in random fashion; they push and jolt one another in a mad scramble to escape from the emitter very much like popcorn on a hot stove. A recent issue of the General Radio Experimenter describes methods whereby these random fluctuations can be compensated.

Diesel Plant Improvements At STERLING, KANSAS

By A. C. KIRKWOOD
BURNS & McDONNELL ENGINEERING COMPANY
Kansas City, Missouri

A THOUGHTFUL MAN once said something about man's good deeds passing unnoticed. Sterling, Kansas, has many good men and one of their good deeds is the creation and management of the city-owned power plant.

Like many another municipal venture, this utility has its long history intertwined with the growth of the city and the surrounding countryside. Starting out as a small steam engine plant, it changed, with the development of improved Diesels, availability of door yard oil, and changes in the relative cost of fuels, to Diesel operation. In 1928 a 400 hp Diesel was installed and in 1931 a 750 hp unit was added.

By 1939 two problems faced the City Commissioners and their City Manager. First, and most pressing, the normal load growth was fast approaching the limit of firm capacity. Part of that firm capacity was made up of two 120 kw steam engines that could not carry their rating. The second problem involved the possible acquisition of a comparatively large block of REA load.

The load growth which so concerned the city officials is shown in Table I and coupled with it is the growth subsequent to 1939. These conditions required action. An engineering report was ordered in June of 1939. The report was to cover the two problems and was to form the basis for determinations of policy—to what extent should new equipment be installed and, should the REA load be taken on, what larger expenditures would be necessary.

For the first condition—normal city and adjacent rural load—it was recommended that 1—500 kw unit be installed. The existing cooling tower was a unit that had been puchased from a nearby plant that had outgrown it. The tower was found to be inadequate and was of the natural draft type. A new induced draft tower was recommended. The switchgear had inadequate interrupting capacity and, due to age, was of a design now considered hazardous. New switchgear, with adequate instruments and proper capacity, was suggested. Minor modifications to the existing building were required to house the new equipment. The estimated cost was $108,200, including contingencies and engineering.

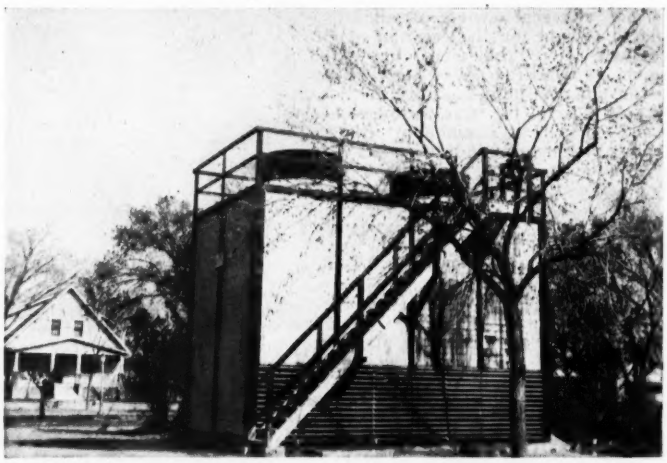


Fig. 2. The cooling tower

Fig. 1. Exterior view of the power plant at Sterling, showing the old and new portions of the building

That part of the report dealing with REA loads presented a different problem. The Ark Valley Electric Cooperative Association was then in the process of developing its first unit or group of consumers. Only general demand and usage data were available and the extent of territory to be served was defined only in a tentative manner.

They claimed 450 consumers under contract and a potential of 900 customers. REA standard data, of that date, indicated an immediate demand of 160 kw with a usage of 388,800 kwhr per year. The engineers' estimate was for an initial demand of 144 kw, 378,000 kwhr per year. It was expected that the full 900 customers would require about 1,050,000 kwhr with a demand of about 400 kw. Parenthetically, the REA used 2,179,300 kwhr in 1943 with a demand of approximately 600 kw. This divergence is due to the acquisition of more

territory by the REA. The REA and city demands are not coincident. The REA power contract was to be for 5 yr. It was therefore proposed that a 700-kw unit be installed to satisfy this possible second condition. The estimated cost was $118,600 including previously mentioned auxiliaries and structures.

In both cases it was recognized that a further installation would be required in several years; about 1948 for normal load and 1944 with the normal load plus the REA load.

After proper deliberation by both the City Commissioners and the citizens, revenue type bonds were authorized and construction work commenced. A contract was entered into with the Ark Valley Electric Cooperative Association. They asked for their first power on May 17, 1940.

Equipment was purchased in line with the engineers' report, some variations being included to further improve the enlargement program. The old steam engines and boilers were sold. The space occupied by the engines was revamped to accomplish several objectives. The engine room is ell-shaped. The new switchgear location, office space, and open floor space for service work, were obtained from the area occupied by the steam engines and old switchgear.

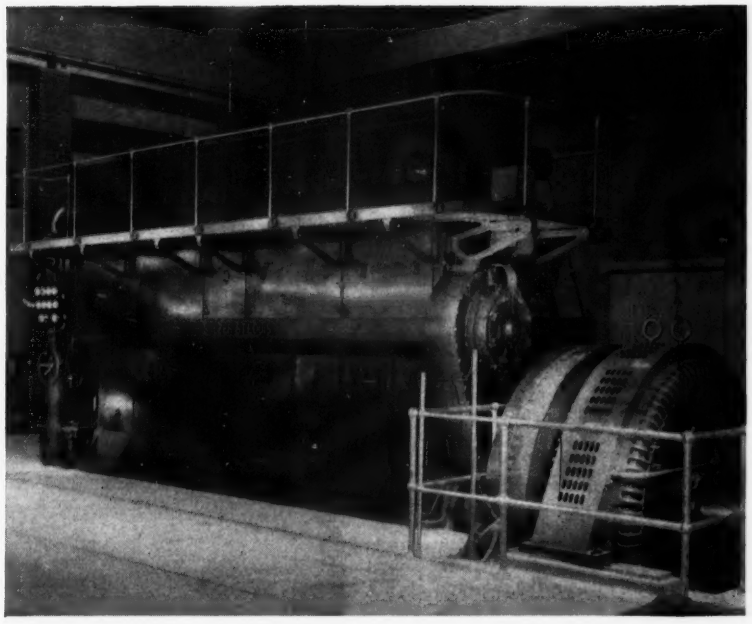


Fig. 4. The new 1000 bhp, 8-cylinder Busch-Sulzer engine

Table I. Load Growth

Year	Demand kw	Generation kw	Sales to REA, kwhr	Net Generation* kwhr
1935	270	1,006,000	0	1,006,000
1936	370	1,262,980	0	1,262,980
1937	390	1,340,400	0	1,340,400
1938	400	1,404,500	0	1,404,500
1939	442	1,572,770	0	1,572,770
1940	620	2,007,300	**354,870	1,652,430
1941	730	2,705,820	999,520	1,706,300
1942	860	3,307,110	1,676,710	1,630,400
1943	910	3,750,940	2,179,300	1,571 640

*Gross generation less sales to REA. REA power is sold on the plant switchboard.
**Seven months' service.

The old boiler room, forming the foot of the ell, was razed, a basement was excavated and a new engine room built. It is adequate for two engines and their auxiliaries including all cooling tower and jacket water pumps for the entire plant.

The new cooling tower is located

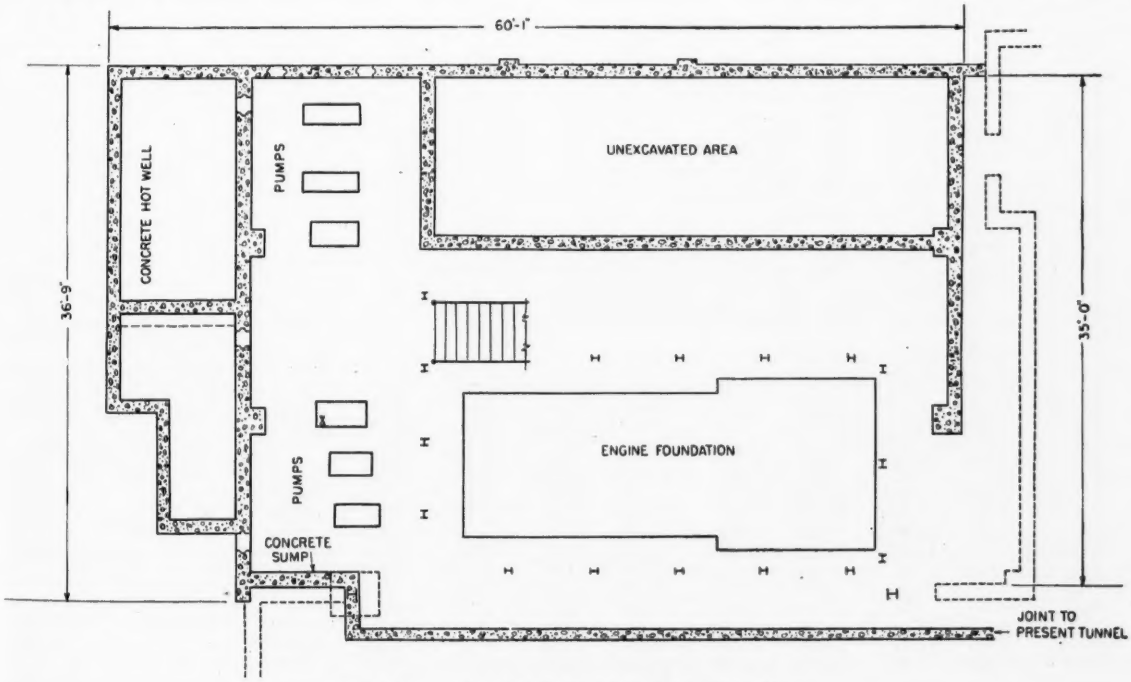


Fig. 3. Basement and foundation plan of the new building

as close to the new engine room as proper design will permit. The tower basin, trash racks, and clearwater inlet are at such elevation that the raw water pumps, located in the new basement, have adequate submergence at all times. Hot jacket water is stored in a concrete well outside the basement wall. It is in two compartments. Gravity lines bring water from the engines in such manner that either or both compartments may be used. Pumps pass the water through coils in the base of the tower and then directly to the engines.

The prime mover is a 1000 bhp Busch-Sulzer type 8-DB-24 8-cylinder engine. It is a 4-cycle, trunk piston type using mechanical injection. Cylinders are 16½-in. diam and the stroke is 24½-in. Speed is 257 rpm. The engine drives an 875 kva/700 kw Westinghouse generator to which is attached a belt-driven Westinghouse exciter. The unit was guaranteed to deliver one kwhr for 0.548, 0.560, and 0.598 lb of fuel at 100, 75, and 50 per cent load, respectively, at 0.8 power factor. The BMEP is 73.5 at full load.

The cooling tower is a Marley Co. No. 12-IDC induced draft cooling tower having two cells each with 72-in. fans employing twelve blades. These two speed fans operate at 464 or 305 rpm, requiring 5.3 or 1.8 hp. Drive is through a "gear-reducer" by a 7½/3.3 hp 1800/1200 rpm motor. The tower is rated 530 gpm per cell, 99.6 F hot water, 86.0 F cold water, 73 F wet bulb with a 2 per cent drift loss. Heat exchangers are built into the tower base. Each is rated at 3,600,000 Btu per hr per cell with 73 F and 130 F water.

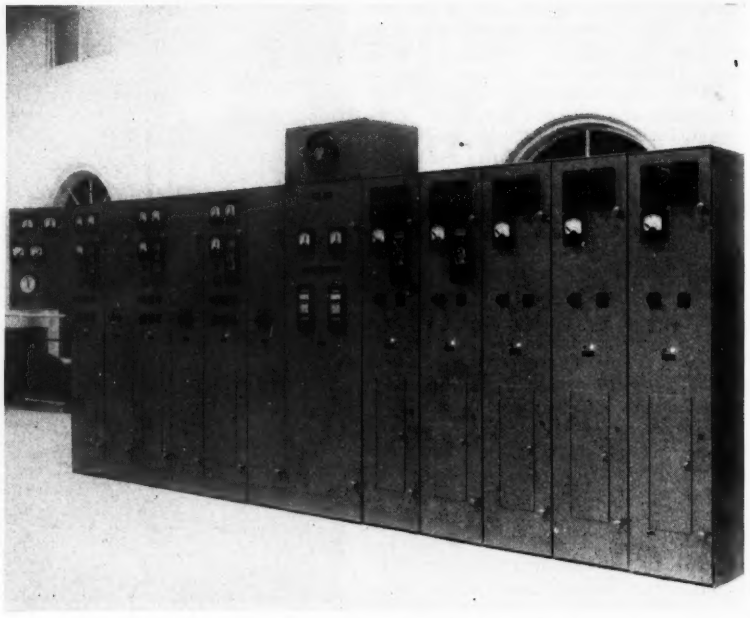


Fig. 5. The all-enclosed metal-clad switchgear

The switchgear, manufactured by the General Electric Co., is of the indoor metalclad type. Breakers are General Electric Co. type FK-142 having an interrupting capacity of 25,000 kva and a one second capacity of 20,000 amp. All breakers are rated 600 amp, 5000 v. Voltage regulators are type GDA-33. The switchgear is finished light bronze.

The cost of the improvements was well within the engineers' estimates. In the following tabulation each item includes allocated costs for engineering, supervision of construction, and departmental overheads properly chargeable to construction. Removal of old structures, construction of new buildings, and installation of piping and wiring was done under force account by the city.

Cost of 1940 Improvements	
Diesel Eng. Generator	$ 58,005.17
Foundations	1,194.02
Cooling Tower	6,485.31
Cooling Tower Basins	1,770.45
Switchgear	16,855.06
Power Wiring	1,193.60
Razing Old Building	915.58
New Building	14,624.78
Auxiliary Equipment	2,396.16
Piping	5,563.00
Compensation Ins.	178.78
Total	$109,180.91

Table II. Generation and Sales, City Load

Year	Generation kwhr	Station Use, Line Loss, Free, City Use, Etc. kwhr	Total Sales kwhr	Commercial Sales, kwhr
1940	1,652,430	516,191	1,136,239	385,963
1941	1,706,300	498,459	1,207,841	404,778
1942	1,630,400	463,224	1,167,176	359,881
1943	1,571,640	427,267	1,144,373	325,737

Table III. Engine Performance for the Year 1943

	Engine No. 1		Engine No. 2		Engine No. 3		Total	Monthly
Month (1943)	Hr Use	Kwhr Gen.	Hr Use	Kwhr Gen.	Hr Use	Kwhr Gen.	Kwhr Gen.	Peak Kw
Jan.	298	57,590	156	46,660	463	220,800	325,050	880
Feb.	262	51,110	212	67,990	411	192,460	311,560	820
March	164	31,830	264	84,000	337	157,620	273,450	790
April	102	15,660	409	130,010	349	165,180	310,850	810
May	57	8,780	334	107,940	399	191,680	308,400	780
June	41	6,380	282	88,870	476	220,200	315,450	800
July	62	9,760	239	71,770	491	250,050	331,580	880
Aug.	202	33,390	298	127,540	349	184,700	345,630	870
Sept.	389	68,720	413	130,660	206	95,600	294,980	830
Oct.	189	37,590	146	42,750	475	223,630	303,970	870
Nov.	252	50,690	156	48,810	445	215,560	315,060	860
Dec.	313	58,780	136	44,340	432	211,840	314,960	910
Year	2,331	430,280	3,045	991,340	4,833	2,329,320	3,750,940	910

	Engine No. 1		Engine No. 2		Engine No. 3		——Average——	
Month (1943)	Gal Fuel Oil	Kwhr Per Gal	Gal Fuel Oil	Kwhr Per Gal	Gal Fuel Oil	Kwhr Per Gal	Kwhr Per Gal	Fuel Cost Kwhr
Jan.	5,040	11.42	4,367	10.68	16,389	13.47	12.60	.0031
Feb.	4,639	11.02	6,385	10.65	14,235	13.52	12.33	.0031
March	2,890	11.00	7,807	10.76	11,689	13.48	12.21	.0032
April	1,520	10.30	12,136	10.71	12,334	13.39	11.96	.0032
May	861	10.19	9,900	10.90	14,289	13.41	12.31	.0031
June	635	10.04	8,229	10.79	16,541	13.31	12.41	.0032
July	944	10.34	6,762	10.61	18,677	13.41	12.56	.0031
Aug.	3,155	10.58	11,842	10.79	13,784	13.30	12.01	.0032
Sept.	6,345	10.83	12 060	10.83	7,205	13.26	11.52	.0033
Oct.	3,355	11.20	3,996	10.69	16,648	13.44	12.67	.0030
Nov.	4,471	11.34	4,487	10.88	15,877	13.58	12.7	.0030
Dec.	5,226	11.05	4,068	10.89	15,516	13.65	12.7	.0030
Year	39,081	11.01	92,039	10.77	173,184	13.45	12.32	.0031

Table IV. Engine Performance, 1935 to 1943

Year	Kwhr Generated — Plant	Eng. No. 1	Eng. No. 2	Eng. No. 3	Kwhr per Gallon — Eng. No. 1	Eng. No. 2	Eng. No. 3	Plant
1935	1,006,000	162,400	843,600	.....	8.49	8.06	....	8.06
1936	1,262,980	856,010	406,970	.....	8.43	8.71	....	8.52
1937	1,340,400	941,300	399,100	.....	8.32	10.04	....	8.77
1938	1,404,500	901,900	502,600	.....	8.42	10.11	....	8.9
1939	1,572,770	970,700	602,070	.....	8.96	10.09	....	9.38
1940	2,007,300	926,350	1,054,390	26,560	9.78	10.51	11.6	10.21
1941	2,705,820	563,670	1,058,290	1,083,860	10.52	10.52	12.54	11.26
1942	3,307,110	386,390	905,810	2,014,910	10.74	10.66	13.04	12.00
1943	3,750,940	430,280	991,340	2,329,320	11.01	10.77	13.45	12.32

Table V. 1943 Operating Costs and Revenues

	Amount	Kwhr	¢/Kwhr
Revenues:			
Residential	$18,573.04	420,843	4.41
Commercial	11,082.07	311,788	3.56
Power	3,409.09	145,576	2.35
Power for Water and Sewage Pumping	1,915.13	152,543	1.25
Window Lighting	306.49	13,949	2.2
Rural Residential	4,838.00	85,509	5.65
Rural Commercial	528.29	12,268	4.3
Rural Power	237.43	1,897	12.51
REA	23,233.00	2,179,300	1.066
Total Sales	$64,122.54	3,323,673	1.93
Free Energy to other City Depts.	(1,574.44)	136,960	(1.15)
Total Sales Accounted for	$64,122.54	3,460,633	....
Line Loss	.....	146,482	....
Station Use	.....	214,225	....
Totals	$64,122.54	3,786,140	1.69
Purchased Energy	.....	35,200	
Generated Energy	.....	3,750,940	
REA Share of Standby Service Charge	300.00		
Penalties, Etc.	71.53		
Non-Operating Revenues	1,487.66		
Total	$65,981.73		

Operating Costs:	
Production Expense:	
Superintendence	$ 1,115.00
Operating Labor	6,092.24
Engine Maintenance	2,517.87
Electrical Maintenance	4.16
Misc. Equip. Maintenance	122.28
Building Maintenance	324.76
Fuel Oil	12,424.36
Lubricants	486.16
Water	243.53
Purchased Power	1,195.85
Stand-by Service Charge	500.00
Operating Supplies	683.02
Total Production Expense	$25,713.23
Distribution Expense	6,887.57
Commercial and General Expense	4,398.73
Total Operating Expenses	$36,999.53
Revenues	$65,981.93
Expenses	36,999.53
Balance for Depreciation, Bond Retirement, Etc.	$28,982.40

Acceptance tests were conducted in December of 1940. Since then the new equipment has successfully carried a load that has far exceeded the anticipated demands. As mentioned in an earlier paragraph the REA load has increased beyond expectations due to the acquisition of additional territory. Table II shows the record of load growth in city load. The decrease in generation (for city load only) is accounted for by decrease in line losses, station use, free service and commercial sales. The latter load is possibly affected by population losses suffered to the military services and war plants. Lack of gasoline has probably reduced the city visits of farm folk. The use of street lights and park lighting has been curtailed in line with patriotic efforts to conserve fuel.

Plant Performance

Like the proof of the pudding being in the eating, power plant design and performance are best judged by operating results. Promises mean nothing unless they are fulfilled. In 1940 the newly improved Sterling, Kansas, municipal Diesel plant promised much for future operations. How well these promises have been fulfilled will now be shown.

The performance of this plant, particularly of the new engine-generator unit, is interesting for several reasons. Probably of most interest is the fact that the performance record was obtained with a normal or swinging load in a normal plant. The relation of unit capacity to load is such that base loading is impossible. However, the operating personnel have adequately understood the capabilities and limitations of the several units and have seen fit to match capacity to load to the best possible advantage. In 1943 the plant accumulated 10,209 engine hours operation. These hours were divided 2331 to the 267 kw unit, 3045 to the 500 kw unit and 4833 to the new 700 kw engine-generator.

Table III shows hours use and generation by months for 1943 for each unit. It also shows the total gross generation and monthly peak demand. The annual average loads were 184,325, and 482 kw for units 1, 2, and 3 respectively. These average loads were 69, 65, and 68.5 per cent of generator rating. Although the per cent loads were nearly identical, the fuel consumption of the 700 kw unit was materially better than that obtained by the older units. This is shown in the lower part of Table III. It is noteworthy that the new unit averaged 13.45 kwhr per gallon during the year and that it obtained 13.65 kwhr per gallon in December, during which month the average load was 70 per cent of generator rating. Fuel cost for the new unit averaged $0.00284 per kwhr or about 8 per cent below plant average.

The record during the years 1935 to 1943 deserves consideration. Table IV shows generation and kwhr per gallon by engines and for the entire plant for these years. It should be noted that with increased load and engines of three different capacities the plant has been operated to give each unit its most advantageous load.

Unit No. 3 was placed in service in December 1940. The REA load was acquired in May of the same year. During August and September of 1943 the city purchased 35,200 kwhr while engine maintenance was underway.

Table V is a summary of 1943 operations as taken from the city records. Revenues and sales by classes of consumers are shown in detail as are operating costs. The free energy furnished other departments of the city is metered as a matter of record. The value of these services is computed on the basis of existing rates. Earnings have been sufficient to amortize in approximately four years the total cost of the 1940 improvements.

These recent improvements, as well as the 1928 program, were engineered by the Burns & McDonnell Engineering Co. T. Marion Heter was the architect. Mr. Robert F. Peart is City Manager and General Superintendent of Utiilties. Mr. A. Fabin is Chief Engineer.

Package Type Power Plants

For shipment by any transportation means, simple installation and speed in putting into operation, design for a 500-kw condensing steam turbine power plant . . . Equipment grouped in 8 functional units and shipped in 24 packages . . . Plant designed to burn wood, peat or low-grade coal . . . Unit design, one boiler per turbine, can be extended . . . Steam conditions 300 psi, 700 F, generation at 400 v, 3 phase 50 cycles, design heat rate 31,000 Btu per kwhr . . . Details of packaging, feedwater and condensing water supply, boiler and auxiliaries turbo-generator, condenser and spray tower

By H. H. Van Kennen and Lester E. F. Wahrenburg

Mechanical Engineers, Peter F. Loftus, Consulting Engineers, Pittsburgh, Pa.

THE PROBLEMS relating to the successful conduct of the war, and to post-war rehabilitation, have created the urgent need for a portable type power plant capable of producing relatively large blocks of electrical power. These plants must be so designed that they can be moved rapidly and readily from one location to another to meet the critical demands for power necessitated by military, industrial, and rehabilitation exigencies. Three such types of portable plants have been developed; these types are commonly referred to as the power train, the floating power plant, and the package type power plant.

The package type power plant, to be discussed here, is made up of the necessary items of power generation equipment, in relatively large, pre-assembled units, each in itself mechanically and electrically interconnected, which can be transported to the required destination by rail, water, or motor transportation and which, upon arrival, can be aligned on a pre-installed, simple, concrete mat or foundation, mechanically and electrically interconnected, and rapidly made ready for power generation.

Requirements Packages Must Meet

This initial conception was born of the exigencies of a world emergency, and certain concessions had to be made in the attainment of the primary purposes, which were as follows:

1. The packages, whether they were crates, bundles, or skidded items of equipment, had to be of easy portability, which involves such matters as distribution of weight within the package, the general size of the package, its shape, and ready means for properly attaching slings for handling if cranes and hoists are available.

2. The grouping of the equipment contained in any one package had to be such that the package could be quickly erected in its proper relationship to other packages, and be as quickly dismantled.

3. The individual packages had to be so arranged and grouped that a minimum amount of field work would be required in the interconnection of the packages making up the complete power plant. This naturally implies a maximum of pre-assembly of the elements of each package. Each individual package had to be mounted on substantial skids.

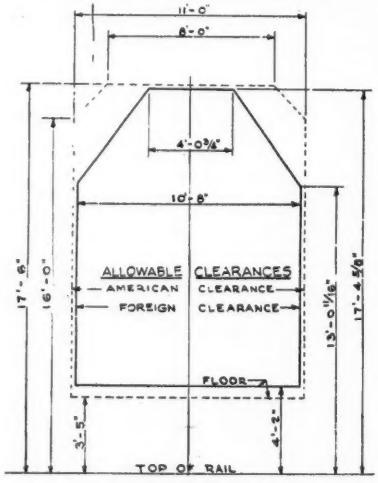


Fig. 1. Composite railroad clearance diagram

4. The physical design and arrangement of the equipment within the package, and its relationship to other packages comprising the complete power plant, is to be such that the required foundations and enveloping structure can be of minimum extent and maximum simplicity. Given proper soil conditions, the ideal foundation would be a perfectly flat slab for the support of all the elements of the plant.

Railway and highway clearances, both in this country and abroad (Fig. 1), place severe restrictions on the width and height of the packages. Handling facilities, particularly abroad, place limitations on the weight of the packages. These physical limitations naturally limited the number of associated equipment items that could be placed in an individual package, and they also had a definite effect on the physical shape of the principal items of equipment contained in each package.

It can be seen that, in general, the foreign clearances were the limiting factors. The contour of the clearance lines of the railways is such that the maximum clearance exists above the center of the railroad car. As a consequence, a boiler of the longitudinal drum type had certain inherent advantages over a boiler of the cross drum type. However, it does not necessarily follow that the cross drum type boiler, by certain adaptations of basic design, cannot be made to fall within the limiting restrictions.

Thermodynamics

The plants discussed herein must be capable of utilizing a fuel of a type which is most abundant in and native to the specific locality designated. Furthermore, we discuss specifically a 500 kw capacity, package type, power plant. Plants of this capacity seemingly are in great demand because of the war's needs, and they have been developed, manufactured, and shipped to the far corners of the world.

Figure 2 shows the heat balance and flow diagram of this plant. The plant heat rate of 31,000 Btu per kwhr is comparable with that to be found in similar stationary plants of equivalent sizes and capacities. The station net kilowatt capacity is approximately 476.

Disregarding for the moment the question of availability of a satisfac-

*Abstract of paper contributed by Power Division for presentation at Semi-Annual Meeting of ASME, Pittsburgh, Pa., June 21, 1944.

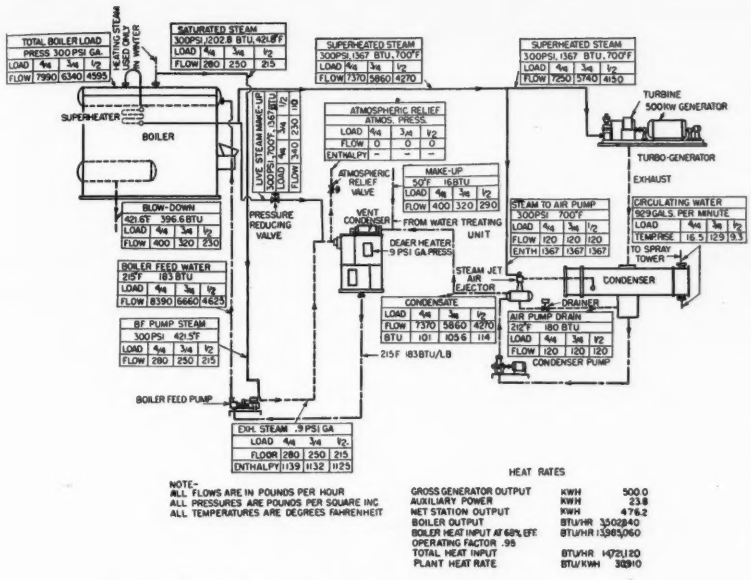


Fig. 2. Heat balance diagram, 500-kw package type power plant

tory and continuous boiler water supply, it would be possible to further simplify the cycle by exhausting the prime mover to atmosphere. However, as the size limitations of the packages imposed themselves most restrictively upon the steam generating unit, it was generally advisable to add to the plant those items of equipment—such as condensers—which would assist in materially reducing the steam demand, and therefore, the unit's physical size, even though doing so might increase the possible total number of packages required.

War-time restrictions dictated keeping the use of cast steel and all alloy steels to a minimum. If cast iron was adhered to throughout, the top limit of steam pressure and temperature was obviously 250 psi and 450 F. However, one of the large manufacturers of small turbines has standardized on a design of turbine using steam at 300 psi pressure and 700 F temperature and requiring a minimum of steel. A study of the economics of the two steam characteristics indicated that a saving of approximately 16 per cent in efficiency could be effected by utilizing the higher steam pressure and temperature conditions. The turbine referred to herein uses cast steel only in the strainer body, throttle and governor valve bodies, and the nozzle block. The choice of this pressure-temperature condition also permitted the use of Series 30 piping rather than Series 60 piping.

Electrical energy was specified to be delivered at 400 v, 3 phase, 50 cycles, 0.8 power factor, and the capacity of the generator was established at 500 kw.

The entire plant was divided into eight functional units, each with its auxiliary equipment. These units consisted of steam generator, turbo-generator, switchgear, condenser, spray tower, feedwater unit, interconnecting piping and wiring, and fuel handling.

Figure 4 shows the general plan and assembly of the 500 kw, package type, power plant. The floor area is 34 ft by 55 ft. Final determinations resulted in a total of 24 packages for the entire power plant; 15 for the steam generator, 3 for the fuel handling equipment (which includes the unusual item of a crusher for each plant), and one each for the remaining 6 functional units.

Steam Generator

The specification requirements for the steam generating unit were particularly severe, inasmuch as it was necessary to make provisions for burning three fuels—wood, peat, and coal of exceedingly low heating value and other adverse characteristics. The boiler, further, was required to deliver 12,000 lb of steam per hr continuously, a quantity some 3500 lb per hr in excess of the turbine and auxiliary requirements, due to the fact that it was considered desirable to provide for a quantity of process and heating steam. And, finally, the complete station had to contain all the elements necessary to bring it into the line without benefit of outside power.

Basically, the unit selected consists of a boiler of the longitudinal drum type, with superheater in the first pass, no air preheater or economizer, a water-cooled furnace equipped with a spreader type stoker for burning coal and peat, and a refractory furnace built under the water-cooled furnace, equipped with sloping stationary bar grates for firing wood.

The appurtenances consist of a forced draft fan to supply air under the grade for peat and coal combustion, and over-fire air for wood burning; an induced draft fan with Venturi type stack; cinder recovery equipment; and the usual complement of boiler ac-

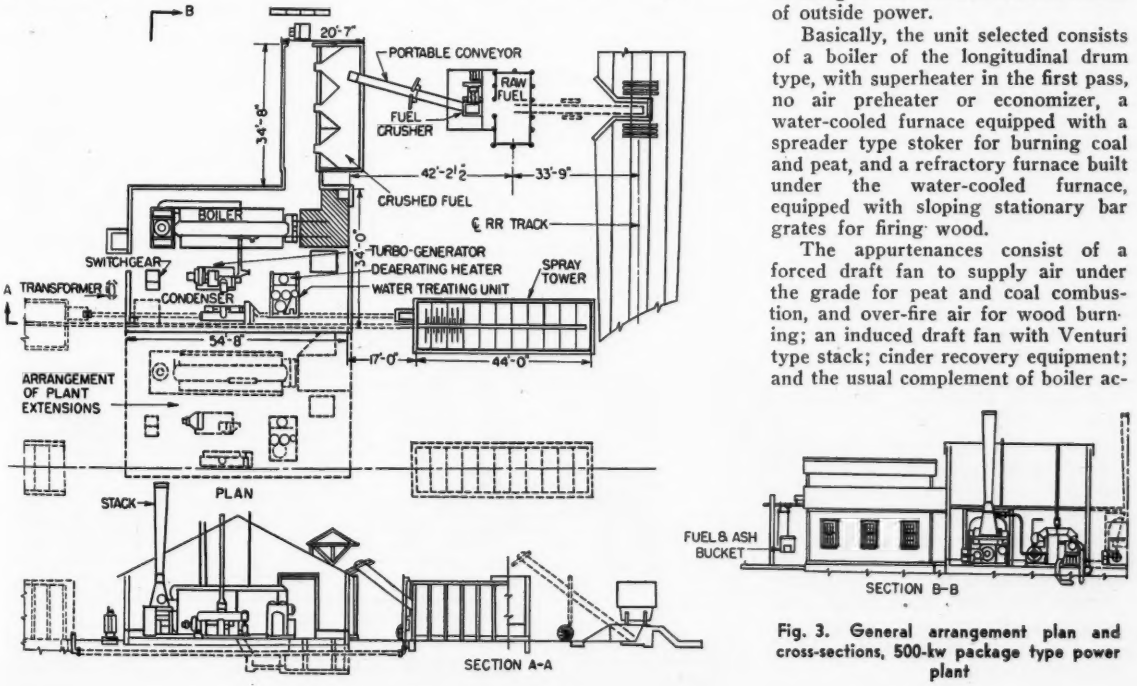


Fig. 3. General arrangement plan and cross-sections, 500-kw package type power plant

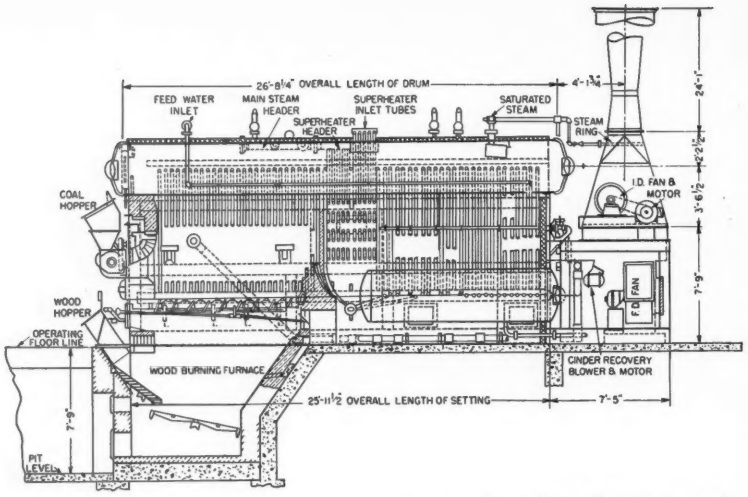


Fig. 4. Cross-section steam generating unit, capable of delivering 12,000 lb of steam per hr, 3500 lb of which are in excess of turbine demand and can be used for process and heating. Firing either by spreader stoker or wood-burning furnace

cessories, including furnace draft regulator, feedwater level control assembly, all piping up to and including the last blow-off valve, and the superheater outlet header. Both the induced and forced draft fans are motor driven; however, in order to provide for bringing the unit onto the line and furnishing enough steam to start the turbo-generator and other plant auxiliaries, a steam aspirating jet ring is provided in the throat of the stack.

The basic operation of starting-up the package type power plant consists of firing the boiler by hand, starting with natural draft, then providing additional draft when sufficient steam pressure is available to furnish steam for the steam ring in the stack. When 50 psi is available, the boiler feed pump will operate. At a higher pressure the turbo-generator is started, exhausting to the atmosphere, and generates sufficient electrical energy to operate the fans and stoker electric drives. The steam generating unit will generate approximately 4700 lb of steam per hr at 300 psi pressure without fans. This quantity of steam will permit about 100 kw generation, operating with atmospheric exhaust.

The necessity of providing for wood burning complicated the general arrangement to a material degree, and accounts for several of the fifteen packages required to ship this unit. If wood firing were eliminated, the complete unit could be placed on a flat concrete slab.

The wood burning provisions are rather unusual. It was contemplated that green logs will be burned, cut from adjoining forests, if necessary, having a length of 30 in. and a diameter not exceeding 8 in. These logs will be manually introduced into the furnace through an air-locked magazine. Natural draft will furnish the primary air, and the forced draft fan will furnish the over-fire air.

The two major packages of the assembly consist of: first, the boiler, superheater, and furnace proper; and, second, a rear assembly upon which are mounted the fans, a section of duct work with dampers, and the lower portion of the stack. This latter package is arranged for easy positioning and attaching directly behind the boiler. To meet weight limitations, it was

Table of Test Results, 500-kw Package Type Power Plant, April 11, 1944

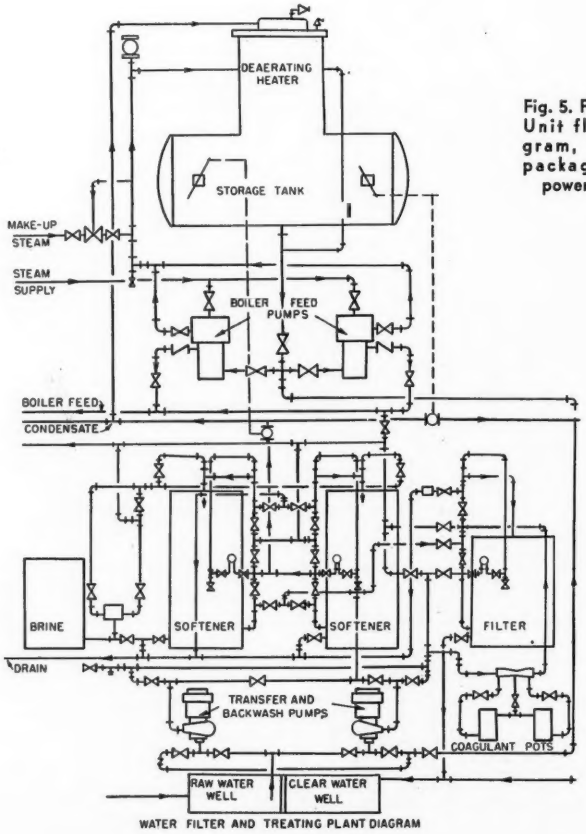
Steam Pressure	Lb per sq in.	292
Steam Temperature	F	658
Turbine Exhaust Pressure	In. Hg Abs	2.83
Steam Generator Output	Lb per hr	8232
Generator Output	Kilowatts	499.4
Auxiliary Power Requirements	Kilowatts	23.8
Net Station Power Output	Kilowatts	475.6
Steam Generator Efficiency	Per cent	72.1
Turbo-Generator Steam Rate	Lb per kwhr	13.8
Net Plant Heat Rate	Btu per kwhr	27,500

necessary to package the stoker fronts with the operating mechanism, and to package the grates separately. To meet physical clearance restrictions, the upper portion of the Venturi stack and the section of forced draft air duct along the side of the boiler had to be packaged separately. For protection against damage in shipment, a considerable portion of the accessories and small piping about the unit, such as water gauge columns and safety valves, were packaged separately, but in all cases the piping removed was prefabricated and sub-assembled in units to permit easy and rapid installation in the field.

Turbo-Generator

No particular difficulties were encountered with respect to the packaging of the turbo-generator of 500 kw capacity. A top exhausting arrangement is used, in keeping with the de-

(*Continued on Page* 120)



WATER FILTER AND TREATING PLANT DIAGRAM

Fig. 5. Feedwater Unit flow diagram, 500-kw package type power plant

Coal Segregation in Boiler Plants*

Meaning of segregation and non-segregation as applied to boiler house practice—Effects of segregation on stoker performance—Why coal segregates—Equipment arrangement that fosters segregation—Means by which segregation of coal can be eliminated

By ARTHUR J. STOCK
Stock Engineering Co., Cleveland, Ohio

COAL SEGREGATION in boiler plants is a cause of fuel waste and increased maintenance, and it limits maximum steam output. Therefore, it is a subject that should be given careful consideration in order that boiler plants may produce maximum results. Whenever coal is moved there is a tendency to separate the coarse from the fines or to mix the coarse with the fines.

As applied to coal in boiler plants, segregation means to separate the larger particles of coal away from the finer particles. If this segregation continues into the furnace, combustion will be found to be irregular because of the different burning characteristics of the different sizes of coal. Irregularity of combustion results in lower efficiency, higher maintenance, and lower maximum capacity.

Non-segregating, which, of course, is the opposite of segregating, means to keep in a mixed condition. Inasmuch as coal is always segregating or mixing as it is hauled, transported, and used, it is extremely difficult to have coal completely mixed at all times.

Fig. 4. A Coarse Coal Streak Down the Center of a Chain Grate Caused by the Meeting of Two Flat Chutes

Effect on Stoker Operation

Coal segregation adversely affects stoker operation, because the ignition of coarse coal proceeds at a different rate from that of fine coal, then too the resistance of the fuel bed to the flow of air varies according to coal size. Those parts of an underfeed or chain grate stoker covered with coarse coal burn faster than those parts of the stoker covered with fine coal. As a result the fire burns shorter where the coarse coal exists, and therefore, a portion of the stoker becomes exposed except for ash. Through that part of the stoker, air passes without having an opportunity to combine with the fuel. This air picks up heat from the furnace which it carries to the stoker. This is a loss of heat. Also this exposed portion of the stoker becomes overheated and burning of the stoker iron follows.

In those parts of the underfeed or chain grate stoker where the fine coal exists, combustion proceeds at a slower rate, which means that it is incomplete when the stoker dumps the ash. The unburned portion of the fuel bed is therefore dumped into the ash pit. This condition results in a high combustible content in the ash. In some cases coal segregation may also cause clinker formation due to the fact that some sections of the fire burn at higher temperatures than others. This is particularly true where low fusion ash coal is burned.

Uniform size distribution of fuel is also important on a spreader stoker. If for some reason the distribution is not uniform, a clinkering tendency will be noted wherever there is piling. Adjustment in the speed of the flipper is provided for changes in size of fuel. When the fuel tends to run large it must be slowed down and when it tends to run fine it must be speeded up. Where more than one feeder is required for a boiler, it is customary to run all feeders from a single shaft, which means that no individual unit can be varied in speed from the others. They all go up and down together.. Therefore, uniformity of fuel to the various hoppers is important, otherwise, one might be throwing too far and the other not far enough. Segregated coal feed on spreader stokers would thus result in loss of combustion efficiency and clinkering.

Fig. 1. Coal Slides Down Steepest Angle of an Inclined Plane

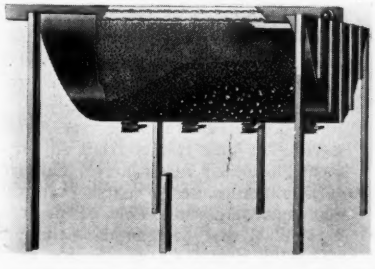
Fig. 2. Segregation in a Pile

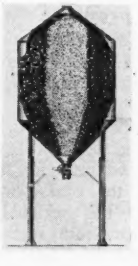
Fig. 3. Segregation in Typical Flat Chute

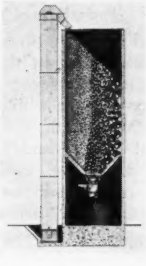
Coal segregation causes higher maintenance of furnaces, because the irregular firing conditions allow certain parts of the furnaces to be at higher temperatures than others. Gas velocities also vary across the furnace. Damage due to these variable conditions is severe in the case of refractory arches over chain grates.

In the case of powdered coal, chute segregation is of no importance, but segregation caused in a bunker which changes the size of the coal from minute to minute does change the grinding capacity of the mill. This is particularly true when there is considerable surface

*Abstract of paper presented at the Semi-Annual Meeting of the ASME in Pittsburgh, June 19 to 22.







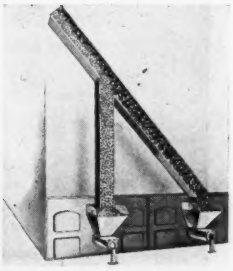


Fig. 5. (Left to Right). Segregation in Coal Bunker Fed by Flight Conveyor without Trough. Fig. 6. Coal Segregation in Silo with Vertical Center Feed. Fig. 7. Coal Segregation in Silo Fed from Side. Fig. 8. Segregation in an Inclined Downspout. Fig. 9. Two Stokers Fed with Single Lateral Downspout

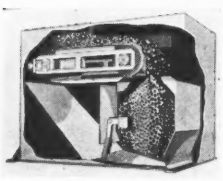


Fig. 10. Segregation in Weigh Hopper
Fig. 11. Segregation in Flat Chute Fed from Left-hand Side
Fig. 12. Segregation in Stoker Hopper Extension Caused by Infrequently Operated Weigh Larry (Larry moved from left to right)
Fig. 13. Segregation in Stoker Hopper Extension Caused by Intermittently Operated Screw Conveyor

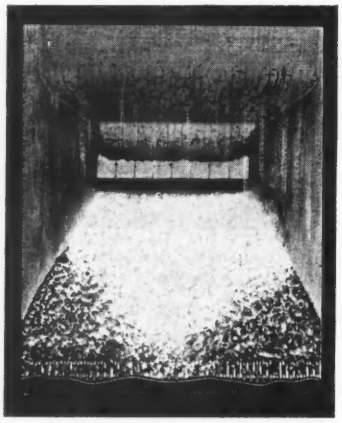


Fig. 14. Fire Resulting From Use of Typical Flat Chute—Coarse Coal at Sides, Fine Coal at Center

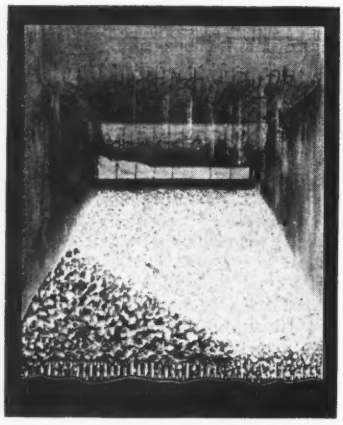


Fig. 15. Fire Resulting from Coarse Coal on One Side and Fine Coal on the Other Such as Results from Equipment Shown in Fig. 11

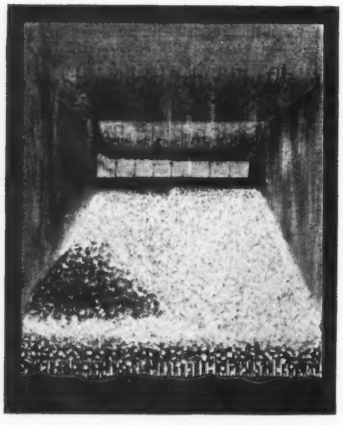


Fig. 16. Fire Resulting from Coarse Coal Seam Running Partly Across the Stoker

moisture inasmuch as the moisture affects the mill grinding capacity of fine coal more than that of large coal. Moisture combined with the fine causes a sticky condition which affects the rate of feed of the feeder or which may cause coal stoppage.

Cause of Segregation

When coal segregation in a boiler plant is considered, every step from the car to the inside of the furnace must be studied. Segregation caused early in this process often cannot be subsequently corrected. Most of the causes of coal segregation in boiler plants are due to the equipment installed in the plant, or to the arrangement of that equipment. Operation is seldom the cause of coal segregation.

If a flat plate were inclined to the horizontal as shown in Fig. 1 and a piece of coal were placed at its upper edge and then released, it would follow the steepest slope down the surface of the plate as indicated.

A number of such pieces of coal released successively from the same starting point would form a pile at the bottom as shown in Fig. 2. The coarse coal would roll over this pile, away from the center of the plate, while the fine would sift through the coarse coal and remain at the center.

Two side guides could be added without changing the tendency for the coarse coal to roll and fine to sift. The addition of a second plate placed parallel to the first as shown in Fig. 3, would form the usual straight fan-shaped chute. If two such flat chutes were to be installed on a stoker hopper, there would be coarse coal down each side and down the center of the stoker. Figure 4 shows the coarse coal streak on a chain grate which results from such an arrangement.

The amount of coal segregation in any installation depends upon the kind of coal, the size distribution, the moisture, the velocity, and the size and shape of the passage-ways through which the coal flows.

Illustrations of Segregation

In Fig. 5 we show coal segregation as it will exist in the coal bunker fed by a flight conveyor without a trough. The conveyor fills the left end first.

In the case of the steel silo with a vertical center feed, Fig. 6, it will be found that fine coal collects in the center of the silo and the coarse will distribute itself around the periphery. When coal is withdrawn from such a silo, fine coal comes out first followed by a mixture, which progressively becomes coarser.

In the case of a concrete silo as shown in Fig. 7, it will be found that a fine coal core exists on the side near the elevator and the coarse material exists on the side away from the elevator. As coal is withdrawn from such a silo, it will be found that the coarse coal remains on the right-hand side of the outlet downspout or chute and fine coal on the left-hand side. If coal from such a bunker is fed to a stoker hopper, whose long dimension is parallel to the plane of the illustration, it would be found that the coarse material would practically all exist on the right side of the stoker hopper and the fine coal on the left side. Such an installation would result in a very poor fire.

On the other hand, if the long dimension of the stoker were perpendicular to the plane of the illustration, and were on the right side, then the coarse material would find itself next to the boiler and the fine material, on the side away from the boiler. Fuel so segregated causes little or no difficulty in burning.

When coal slides down a sloping downspout, the coarse coal gradually rises to the top of the downspout and the fine coal sinks to the bottom. Figure 8 illustrates this condition. Trouble exists in many installations of two single retort stokers because of this fact. Figure 9 shows such an installation.

Figure 10 shows segregation as it takes place within the typical apron feed hopper scale. The coal slides off the head pulley of the feeder in such a manner that it throws the greatest amount of the coarse coal to the right-hand side of the weigh hopper. In the event the coal scale is installed with the feed belt parallel to the stoker hopper, then coarse coal will be at one end of the stoker hopper and fine coal at the other. But if the coal scale is installed with its feed belt running toward the boiler front, then the coarse coal will be on the boiler side and the fine coal will be on the aisle side and no trouble will be experienced.

Figure 11 shows a flat chute feeding a stoker hopper which has its inlet flange on the left side. This design puts a large proportion of the coarse coal on the right-hand side and the fine coal on the left-hand side.

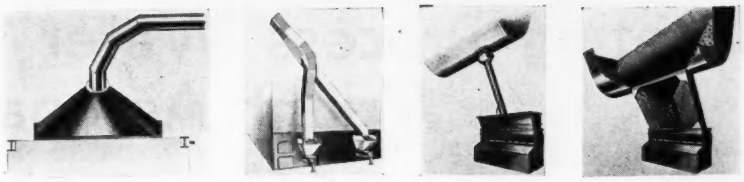
Figure 12 illustrates the type of coal segregation that results from an infrequently operated weigh larry. This type of operation causes a coarse coal seam that runs across the flow of the coal. A similar coal segregation pattern is caused by a screw conveyor that is installed along the top of the stoker hopper and that is operated only periodically. This is illustrated in Fig. 13.

Fig. 17. Plan View of Turned Downspout to Make Correction for Downspout or Silo Segregation

Fig. 18. Downspout Division Arrangement to Offset Lateral Downspout Segregation

Fig. 19. Hand Swung Spout

Fig. 20. Segregation in Constant Width Chute With Low Bunker



Appearance of Fires with Segregated Fuel

The effect of the segregation caused by the simple fan type of chute on the fire is illustrated by Fig. 14. Note the short fire along the sides of the stoker and also the erosion of the side walls and arch where the combustion rate is high. The short fire uncovers part of the stoker allowing excess air to pass through and the stoker iron to be damaged. Also note the long fire in the center where unburned fuel is dumped into the ash pit. Similar fires are the result of a single downspout, a weigh larry or swinging spout which is allowed to stand with free discharge in the center of the stoker hopper.

Figure 15 shows the type of fire that results when the coarse coal is all on the one side and the fine coal, on the other, such as would be the case if the arrangement of equipment as shown on Fig. 11 were employed.

With the type and operation of equipment as shown in Figs. 12 and 13, segregation will result in a fire condition such as shown in Fig. 16. These cross holes in the fire will have the same time frequency as the frequency of operation of the stoker hopper filling the equipment.

Elimination of Coal Segregation

What should be done in order to correct coal segregation? Bunker segregation in general can be eliminated to a certain degree by multiple points of loading. In the case of a flight conveyor as shown in Fig. 5, a trough should be provided with outlet gates. These gates should be opened and closed in such a manner that the bunker will be loaded in horizontal layers instead of from one end. In the case of a silo with center feed as shown in Fig. 6 or a concrete silo as shown in Fig. 7 or in some similar coal bunker installation, it is often possible to reduce the amount of bunker segregation by the employment of chutes within the silo or bunker.

In some cases of silo segregation it is possible to move the elevator 90 deg in plan and thereby change the segregation pattern to one that will do little harm to the fire. Segregation in downspouts can be eliminated by turning the discharge of the downspout toward or away from the boiler. Such an arrangement is illustrated in Fig. 17, which shows a plan view of a downspout which connects a coal silo with a conical distributor.

In order to eliminate coal segregation in downspouts feeding two or more stokers as shown in Fig. 9, a vertical division of the coal flow should be made as shown in Fig. 18. The elimination of segregation caused by coal scales can be accomplished by so arranging the scale that the feed belt flows toward or away from the boiler.

Many plants have employed the hand-swung spout as illustrated in Fig. 19. This arrangement consists of a single, pipe-like spout with a hinged upper portion. A handle is provided so that the operators can swing the downspout from side to side. For best results the spout should be swung frequently and a coal valve at the spout outlet should be closed after the spout has been swung.

Mechanically operated swinging spouts are available. These give satisfactory results from the segregation point of view if the spouts are swung the full width of the stoker hopper and if the speed of the spout is reasonably rapid.

In some plants a chute the full width of the stoker hopper is run up to the bunker. Inasmuch as there is no change in cross sectional area, such a chute will not cause segregation within itself. However, this design makes it imperative that there be no bunker segregation, otherwise the bunker segregation will travel directly through the chute itself. Likewise the length of the bunker should be substantially the same dimension as the length of the stoker hopper. If the bunker is longer than the width of the chute, then serious segregation will exist when the bunker is low, because the coal fills the chute from the parts of the bunker not directly in front of this stoker. Such a condition is illustrated in Fig. 20.

Weigh larries can be employed to eliminate segregation in stoker hoppers. In order to do so, it is necessary to move them frequently from one side of the stoker hopper to the other. It is also necessary to close the coal valve at the weigh larry hopper outlet so that the larry does not discharge freely into the stoker hopper when it is standing still. If the larry is moved sideways at infrequent intervals, segregation will be caused as shown in Fig. 12 and if the larry is allowed to stand with free discharge of coal, the segregation will be caused in the stoker hopper as shown in Fig. 3. Good results or poor results will be obtained with the larry depending upon whether or not the operators put sufficient effort into their job to get a reasonably non-segregated fuel feed to their stokers.

The conical design of distributor has proved to be satisfactory in eliminating chute segregation. The operation of this type of chute or distributor may be explained as follows: If a lump of coal were placed at the apex of a cone, the axis of which is vertical, and then released, it would slide down any element of the cone, such as A, B, C, or D, Fig. 21. Now if a number of pieces of coal were placed at the apex of the same cone and released, the condition shown in Fig. 22 would result, wherein all the coal, regardless of its size or shape, would be equally distributed around the cone.

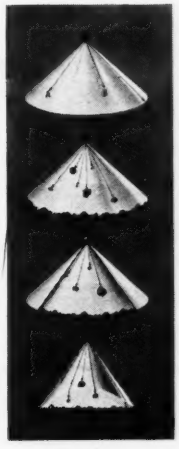


Fig. 21. Coal Slides Down any Element of a Cone

Fig. 22. Coal Distributed Around a Cone Regardless of Size of Coal

Fig. 23. Sector of a Cone Works Same as Complete Cone

Fig. 24. Lower Edge of Cone Removed in Order to Make Conical Distributor

A segment of a cone, as in Fig. 23, would produce the same result. In order to deposit the coal along a straight line, the conical segment is cut by a vertical plate, as in Fig. 24. The coarse and fine coal remain uniformly mixed in this vertical drop, since the flow of the coal particles is parallel. The conical non-segregating coal distributor is formed by adding to such a conical segment two side plates, an entrance flange and another similar conical segment to act as a coverplate. Figure 25 shows the typical installation of such a distributor.

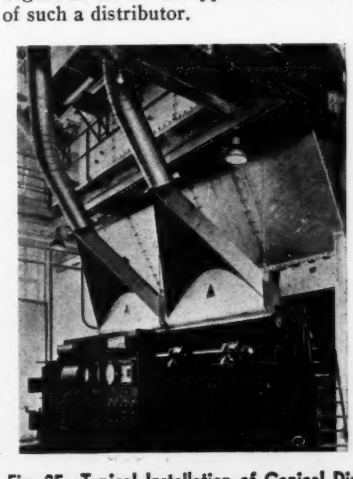


Fig. 25. Typical Installation of Conical Distributor

Treating Process Water *for* Wright Aeronautical

Part II

In the first part of this article which appeared on page 84 of the July issue, the authors outlined the general design of the water treating system at the Wright Aeronautical Corp. plant at Cincinnati. Now, they continue the discussion, and present the details of the filtration system and the control system. Complete details are given of unusual process for recovering water softening sludge and producing calcium carbonate for market, first industrial installation of its kind in this country

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HAVING COVERED the general features of the water treating system at the Wright Aeronautical Corp. plant we will now proceed to a consideration of the filtration system, the method of recovering calcium carbonate from sludge and the control system; the latter is of particular interest.

Eight gravity filters are provided (Fig. 5), each filter 15 ft by 30 ft and arranged in pairs for twin operation with a waste gullet between each pair.

Water is normally filtered at a maximum rate of 2.75 gal per sq ft per min. The filter media is anthrafilt with a top layer of 30 in., having an effective size of 0.63 to 0.73 mm. The supporting beds consist of four layers of graded coal ranging in size from 3/16 to 13/16 in. This in turn rests on a "Wheeler" false bottom under drain system. Wash troughs are designed to handle wash water rates up to a maximum of 12 gal per sq ft per min and a rate of 10 gal per sq ft per min is normally employed to give the desired filter bed expansion. Palmer filter sweeps are provided to assist with the backwash operations and aid in maintaining clean filters with a minimum of backwash water. Normal filter runs of 5 to 7 days is average and filters are backwashed when the loss of head reaches 6 ft. Water required for backwash is only 0.25 per cent of water filtered.

Each filter is equipped with a Venturi type rate of flow controller, loss of head and rate of flow gage, and hydraulic operating valves. One operating table is provided for each pair of filters (Fig. 6).

Backwash water is taken from the discharge of the service water pump from the clear well through a rate of flow controller. The setting on this controller may be varied by the operator in the filter room as desired. The backwash water flows to a backwash water storage tank and is slowly returned to the accelerator softening basin so that all backwash water is recovered in the process and all sludge discharged from one central point, namely, from the softening basin. The filter rate of flow controllers prevents any one filter from taking a larger share of load than a safe maximum and will also throttle

* Figs. 1 to 4 appeared in Part I of this article on pages 84-87 of the July issue.

Fig. 5* (Below) One of the four filters in the filter room of the Wright Aeronautical water treating plant

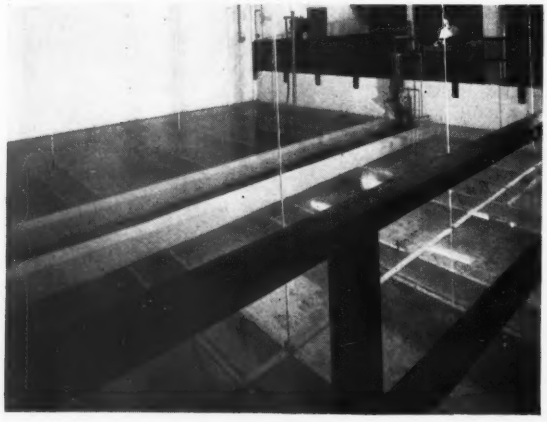
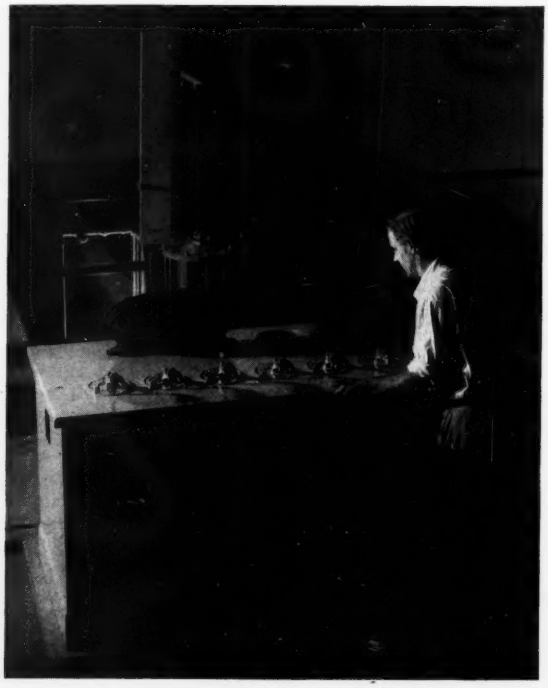


Fig. 6. (Right) Controls in the filter room of the water softening plant



the flow on the filter with a lowering level on the filters. Filtered water is discharged directly to the clear well located below the filters and the filter pipe gallery.

Chlorination

Bacteria count in the raw well waters has been found consistently low, seldom exceeding 50 or 100 per ml. Excellent sterilization is effected by the softening process and any residual bacteria would normally be removed on the filters. As a further precaution, however, a solution of calcium hypochlorite is introduced at the recarbonation basin in sufficient concentrations to maintain a residual chlorine content on the clear well water of 0.2 ppm.

Calcium Carbonate Recovery from Sludge

It was early recognized that disposal of the sludge from the cold process softener would present a problem as there was no adjacent land where this sludge could be lagooned in a satisfactory manner for an indefinite period of time and if the sludge were merely dewatered and hauled to waste, an appreciable expense would be incurred. The solution of this problem at this plant is novel in that it is the first industrial water treatment plant with complete facilities for recovery of a valuable product from the water softening sludge. With present operation, there is approximately 7000 tons per year of solids containing approximately 12 million gal of sludge to be eliminated from the system and with peak operation, this figure will double. Recognizing this problem when the necessity for a water treating plant was determined, pilot plant experiments were started on sludge that would result from cold process treatment of this water, and discovered it would be possible to take this water softening sludge with approximately 85 per cent calcium carbonate and to purify the sludge, rejecting the major portion of magnesium precipitate, iron and alumina hydroxide organic matter and silica by a centrifugal classification method and obtain a product that would be at least 96 per cent calcium carbonate. This is the most important step in the entire process as it has not been possible heretofore to satisfactorily handle water softening sludges because of the impurities present, to obtain a high grade calcium carbonate that could either be recovered as calcium carbonate or to be reburned to lime and used over again in the water softening process. There are no commercial installations in this country where a water softening sludge is being treated and calcined to recover lime because of this difficulty with impurities. Having obtained a satisfactory answer to this major problem, the plant was then confronted with the choice of taking the purified calcium carbonate resulting from this process and recovering as calcium carbonate, to be sold on the market as such, or to take the purified sludge and to recalcine and recover lime to be reused in the process of water treatment.

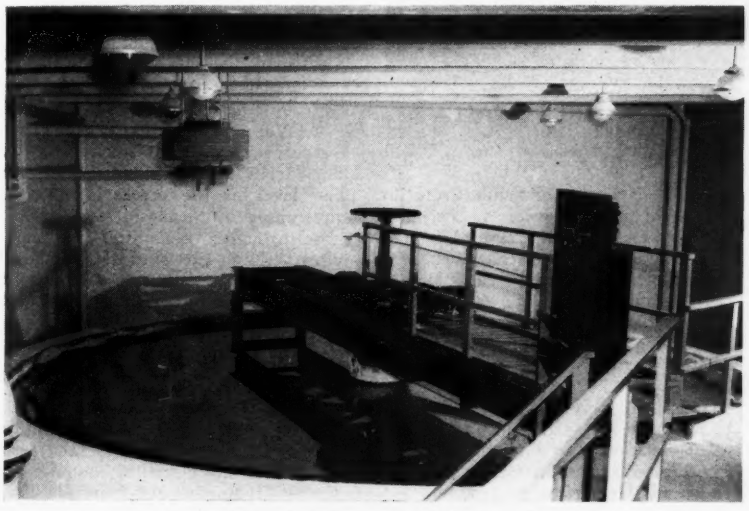


Fig. 7. The Dorr thickener in water softening plant No. 2

A study was made of the economics of both systems and it was determined inasmuch as lime is relatively cheap at this plant and because a satisfactory market could be found for calcium carbonate it would definitely pay to install a calcium carbonate recovery system. It was also determined, however, in spite of the fact that lime at this plant is relatively inexpensive, it would have been possible to have installed a calcining system to have produced lime for a lower cost than the cost for which it was being purchased on the open market.

Based on original research and the pilot plant tests, the sludge recovery system was designed and installed as an integral part of the No. 2 water treating plant and is contained in the same building (Fig. 2). Sludge from No. 1 and No. 2 water softener systems are handled in the same recovery system. The sludge discharged from the softeners contains 3 to 5 per cent solids and is pumped from the sludge pump to a weir box where the flow is split to two Dorr thickeners (Fig. 7), 26 ft diameter by 12 ft deep. The clarified overflow water from these thickeners is returned to the softener and recovered. The settled sludge is collected by the thickener rake to the center of the tank and withdrawn by pumps, either for recirculation to the thickener or for feed to the Bird centrifuge (Fig. 8). The sludge from the thickener contains 12 to 15 per cent solids.

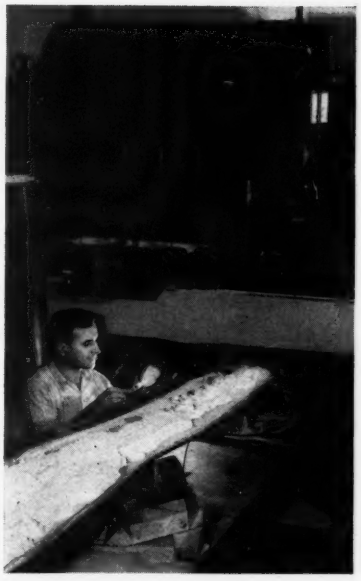


Fig. 8. Taking a sample of the "cake" which is going up an endless belt to the dryers where it will be sacked to be used for paint and phonograph record fillers as well as for grit for tooth paste

The classification previously described is effected in the centrifuge and this is designed to vary the speed or the point of take-off for waste liquors and the magnesium salts and other impurities are removed from the sludge and contained in the reject from the centrifuge which will normally run about 2 per cent solids and will take off 15 to 20 per cent of the solids fed to the centrifuge to waste. This reject is allowed to flow to the sanitary sewer and these solids being light and flocculent are not objectionable in this sewer system, whereas the straight sludge could not be so handled.

The centrifuge is a horizontal unit (Fig. 8) with a cone shaped imperforate basket and a spiral conveyor operating at a slightly lower speed than the basket acting to continually remove the dewatered sludge cake. The discharged cake contains 60 to 65 per cent solids and 35 to 40 per cent moisture.

The solids are carried on a belt from the centrifuge discharged to a Raymond flash dryer system, consisting of a mixer of the pug mill type, to centrifugal flash dryers with cyclone, and a furnace. The sludge cake is first passed to the pug mixer where it is mixed with a sufficient amount of dry calcium carbonate returned from the second stage dryer to

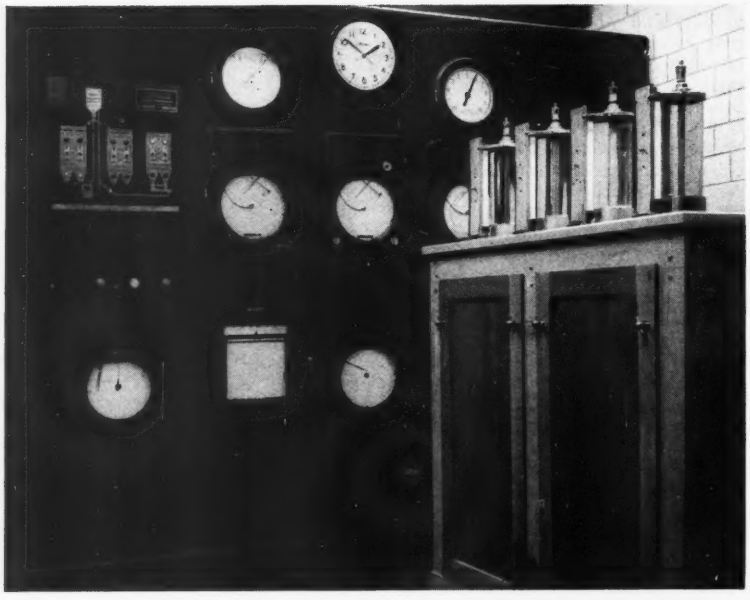


Fig. 9. Panel board and water testing equipment in water softening plant No. 2

reduce the cake to a granular mass and eliminate the sticky characteristics. The moisture is reduced in this pug mill to approximately 13 to 15 per cent. The mill discharges into the first stage dryer consisting of a high speed fan, taking gases from the furnace and a controlled amount of the vent from the second stage cyclone and mixing thoroughly with the wet material previously prepared in the mixer and conveying this to the first stage cyclone separator. The vent from this first stage cyclone is directly to the stack with vapors at approximately 140 to 160 F and this constitutes the only vent on the system for discharge of the moisture from the calcium carbonate. The solid material from the first stage cyclone is above the inlet duct to the second stage dryer, which mixes this partially dried material from the first stage with furnace gases and discharges them to the inlet of the second stage cyclone. Temperatures of 250 to 300 F are maintained in the second stage cyclone and the dry product, containing less than 0.5 per cent moisture drops past an automatically controlled damper known as the dry divider. A portion of the calcium carbonate is returned to the pug mixer and the remainder drops to a screw conveyor on the top of the calcium carbonate storage bin and then into the bin. It will be noted the flow of solids and gases in the dry system is counter-current and the amount of calcium carbonate dust discharged to the atmosphere is negligible inasmuch as the vent is from the first stage cyclone and the solids in that cyclone are still sufficiently wet to obtain a sharp separation of the solids from the vapor. The calcium carbonate storage bin has a capacity for 300 tons of calcium carbonate. From this bin, calcium carbonate is fed by a conveyor system to a packaging machine capable of packaging 9 tons per hr in 100 lb bags.

There is also a connection from the bottom of the storage bin to the pneumatic receiver used for unloading lime and soda ash, with a discharge chute to the rail track to permit bulk loading of calcium carbonate in rail cars directly from storage. The dewatering and drying system has the capacity for 4200 lb of solids per hr or 50 tons per day.

The calcium carbonate now obtained from the system has an average particle size of 5 to 7 microns and will run 96 per cent minus 325 mesh. The solids will run 94 to 96 per cent calcium carbonate. A slight alteration is now planned to the system that will improve the purity of the calcium carbonate to 96 to 98 per cent $CaCO_3$ and further improve the product by elimination of a small amount of coarser particles, giving a product that will be 99.5 per cent or better minus 325 mesh. The calcium carbonate obtained from the system is fairly white, although it does not have the brilliant white of the precipitated product available on the market, primarily due to a small amount of residual iron, that will average 0.15 to 0.2 per cent. Some studies are planned for still further improvement of the product to further eliminate this impurity.

The calcium carbonate produced by this system is now being sold on the market and has a sufficient value, as originally contemplated, to more than justify the installation of this system of treatment and recovery and the further minor changes now planned on the system will further improve the market value of the product.

Meters and Controls

Considerable study was given to the instrumentation on both these water treating plants and several of the instruments and controls employed are rather unique and deserve some comment.

All meters and controls, with the exception of the meters on the operating table for the filters, are centralized on a single control meter panel (Fig. 9) in the laboratory.

1. Water entering the plant is metered, and the flow can be changed or altered at the will of the operator by means of a control on the operating board. To increase or decrease the rate of water flow to the softener, the operator merely turns the rate changer moving a pointer for the desired flow. This opens a valve in the raw water line and the valve position is held at the point to give the desired flow constant regardless of change in inlet pressure.

The valve in the raw water line is actuated by turning a knob on the raw water meter. This operates the boiler control drive (Fig. 10), then the standatrol A-1. When the standatrol setting is satisfied, the valve automatically repositions itself to maintain a constant flow.

2. Water to the softener flows from a reservoir located on a hill at a distance from the water softening plant. The level of the reservoir water is transmitted by means of electrical impulse through a transmitter over phone wires through the central switchboard to the water softener, and converted to a level recorder for a continuous record.

3. Chemicals for softening are automatically proportioned by a control system actuated by the rate of water flow, feeding chemicals for a portion of a 60 second cycle. As the rate of raw water flow increases, the "on" period of the electrical impulse increases feeding more chemicals. The rate of chemical feed may be changed by the operator by an adjustment on the individual feeders, such changes being made to meet changing conditions in the chemical content of the water as determined by the operator's tests and values indicated by the recording pH meter.

4. An indicating and recording pH meter is provided on a continuous sample line from the mixing chamber of the softener. It is desired to hold this pH value constant at approximately 9.6 to 9.8 for maximum efficiency in reduction of calcium hardness. Any change in chemical feed or change in characteristics of the water being treated is almost immediately reflected by the meter by a deviation from the desired pH value, and permits the operator to check immediately and make the desired correction.

5. A second pH meter is installed to continuously indicate and record the pH value of the water being discharged from the recarbonation basin and this pH meter is also connected with a controller. The flow of flue gas to the recarbonation system is *metered* and the flow of gas is *proportional* to the flow of water to the softening basin. The flow of gas desired, however, also de-

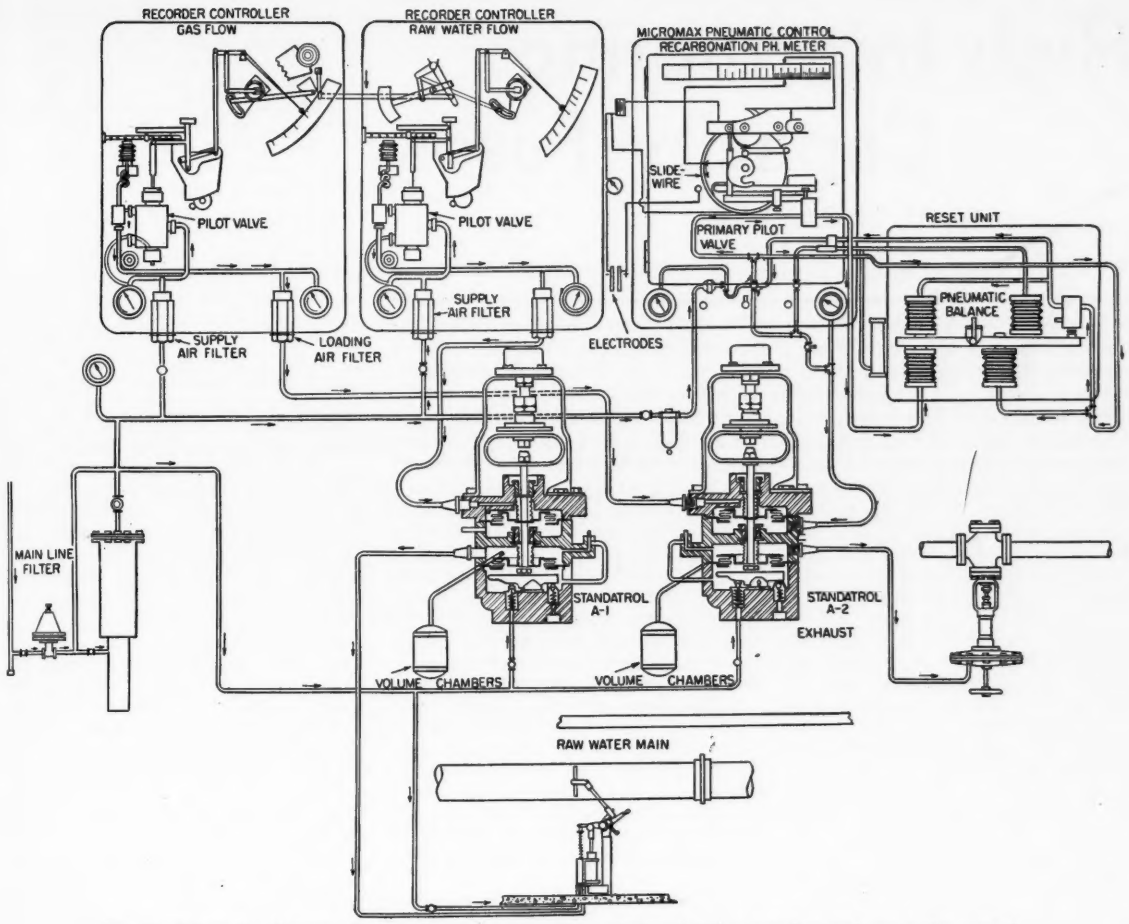


Fig. 10. Schematic diagram of the Micromax pneumatic control and Bailey gas flow and raw water control

pends on the pH value of the water from the softening basin and the per cent CO_2 in the flue gas. By reference to Fig. 10, the flow of gas is regulated as follows: the raw water meter and gas flow meter combine to make a ratio control. The recording pH meter in turn superimposes a loading on this ratio controller that will automatically compensate for changing CO_2 content or a changing pH value of the softened water. Hence, all three variables are compensated to give the desired pH value of water leaving the recarbonation basin and the gas flow is varied to give this constant pH value and is entirely automatic.

The details of the control are shown in Fig. 10 and will be explained somewhat in detail.

It has been mentioned that the raw water flow is increased or decreased manually by adjusting the knob on the raw water flow meter. This change is, in turn, transmitted through linkage to a gas flow meter.

This motion operates a pilot valve proportioned to the water flow and sends an air impulse to the top chamber of the standatrol A-2. The pressure exerted in the "A" chamber of the standatrol is ultimately taken from chamber "C" to the control valve on the gas line to the recarbonation basin.

When the pH control point is satisfied, the control valve remains in a position to supply the correct amount of CO_2 for proper recarbonization. If, however, the pH is not satisfied because of either changes in the raw water hardness or changes in the percentage of CO_2 being supplied, the pilot valve in the Leeds and Northrup Micromax is altered by the measuring device on the pH control. This positions the pilot valve to supply an outlet pressure which is then a direct measure of the pH being measured.

Since a lag in the control is not desirable, the pressure from the primary valve in the Leeds and Northrup instruments acts on the reset mechanism to regulate the stem position of the secondary pilot valve. From the secondary valve, the pressure is taken to chamber "B" of the standatrol and aids in actuating the control to operate the CO_2 control valve.

If the controls are out of service, the control valve can be operated from the meter panel by manually changing the air pressure at the control panel.

On straight hand control, the control in the Leeds and Northrup Recorder and the Reset mechanism are isolated and the CO_2 control valve can be manipulated as desired.

6. From the recarbonation basin, the water flows by gravity to the filters. The flow of water through the filters is maintained at the desired rate by the rate of flow controller installed in the outlet line from each filter (indicator shown Fig. 6), and is throttled with any drop in level on the filter. The operators keep a sufficient number of filters on the line at all times to handle any maximum flow from the softener.

7. Water from the filters is discharged to the clear well and a level gage records the level on the control panel. This instrument is equipped with high and low alarms with indicating lights.

8. Water from the clear well is pumped to the system on which floats an elevated storage tank. An automatic control starts and stops these pumps to maintain the desired level in the elevated storage tanks and in addition gives the operator a continuous record. In connection with this control and the elevated tank, an altitude valve is installed in the line at the base of the elevated tank. This prevents the elevated tank from overflowing while the pumps continue to supply the demand, or, in case of line breakage, the valve closes preventing loss of water in the elevated tank.

9. Rate of backwash is controlled by a rate of flow controller and indicated on a meter on the filter operating floor, as previously described.

(*Continued on Page* 126)

High Interrupting Capacity Fuses

By H. H. FAHNOE
Protective Devices Engineer
Westinghouse Electric & Manufacturing Co.

In the July issue Mr. Fahnoe described the general application of high interrupting capacity fuses and their characteristics as compared with circuit breakers. The fuse, as Mr. Fahnoe pointed out in his first article, despite its extreme simplicity, is a highly reliable protective device and deserves careful study when protection of electric circuits is under consideration. In this article he presents some specific applications of the high interrupting capacity fuse

HAVING CONSIDERED the general aspects of fuse applications, we can now investigate specific applications particularly suited to central station systems. Starting at the generating station, Fig. 1, there are a few but very vital possible uses for fuses. If a plant having a bus short circuit capacity of 1500 mva at 13.2 kv is considered, all potential transformers for relaying or metering should definitely be provided with fuses to isolate a faulted transformer from the bus with an absolute minimum of disturbance. In the past, this has been accomplished by using fuses with current limiting resistors. Such resistors require space and are a potential source of trouble. Current limiting fuses are greatly preferred since they are more effective in limiting fault currents and do not have excessive resistance to affect phase angle of transformers used for relaying or affect accuracy on metering transformers. Converting the bus short circuit capacity of 1500 mva into rms amp we get 66,000 rms amp symmetrical. Since the fuse operates in the first half cycle of short circuit, it is necessary for it to handle the possibility of a totally asymmetrical short circuit of 106,000 rms amp. The fuse on these potential transformers should have an interrupting capacity equal to this value. In addition to protecting the bus from a faulted transformer it is very desirable to protect the transformer from a secondary short circuit. A 13.2 kv indoor potential transformer must be cleared from the line in less than 2 to 3 sec to prevent dangerous pressures in transformer and release of large volumes of combustible and conducting smoke. Since the primary current on secondary short circuit is only 2.5 amp, it is seen that a very low ampere rated fuse is required, preferably ½ amp. A 1 amp fuse with a minimum melting current of 2 amp at 300 sec would not provide adequate protection. A contracting requirement is that the fuse must withstand magnetizing inrush current which may read a value as high as 6.5 amp in the first half cycle. Fuses having adequate thermal capacity to meet this condition yet retain fast blowing characteristics on secondary short circuit currents have been developed by combining fuse elements of different characteristics in a single fuse. Current limiting fuses are also indicated for small operating transformers. Here selection is based on interrupting capacity requirements and provide only short circuit protection to system as secondary circuit breakers or fuses are generally provided to handle short circuits on the low voltage side of the transformer. The current rating of the fuse is selected so that it will withstand the maximum intermittent load current such as caused by closing circuit breakers rather than on rating of transformers.

Proceeding to the 110 kv transmission circuit the possible applications include fuses on 110 kv potential transformers to protect the bus from faults in the potential transformers. Fuses are occasionally used as an isolating means for lightning arresters particularly if the incoming lines are vulnerable to direct lightning strokes. In both these cases system short circuit protection is the sole requirement and the selection of fuse ratings is based on surge currents which must not blow the fuses. Advancing along the 110 kv line for 100 miles we come to a point where it is necessary to tap the main line to supply a town "B" some 25 miles from the main line. As the load on this branch tap is only a small percentage of the capacity of the line it is desirable to isolate this branch in case of a fault without opening the entire line. Fuses are not recommended for this application since such an overhead line is exposed to lightning which would cause excessive outages. A reclosing breaker would be recommended since faults on a transmission line are generally cleared by a short period of de-energizing. At the step-down substation at the end of the branch the relatively small load is carried by a single bank of transformers and is of such nature that continuity of service is not imperative. Therefore fuses can be used to provide a short circuit protection on the primary of the transformers. A secondary circuit breaker is used to provide overcurrent protection to the transformer and to clear all faults on the low tension bus and feeders. The ampere rating of the fuses is selected to coordinate with the relays operating this secondary breaker so that the fuses operate only on a fault in the transformer or high voltage bus. See Fig. 1. Advancing another 50 miles along the line we pass through mountainous country where there are numerous small hydrogenerating stations as at "C". Here to simplify relaying on the main circuit, fast operating fuses are indicated as the short circuit protective device. Due to the small capacity of these stations, economies dictate against the use of circuit breakers at such locations. At the line terminus at city "D", fuses are ruled out even though fuses having adequate current carrying capacity are available. Transformers of this size are

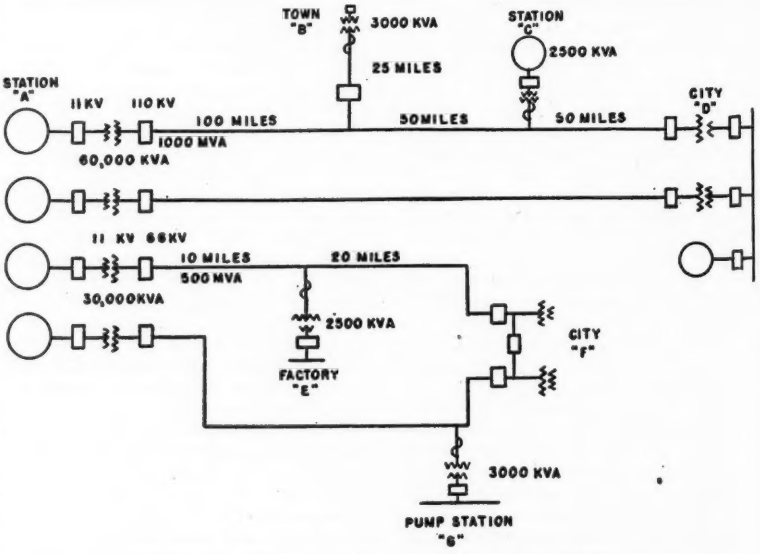


Fig. 1. High Voltage Transmission Circuit

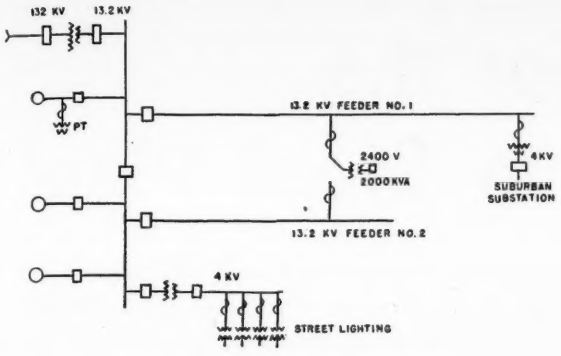


Fig. 2. Metropolitan Distribution Circuit

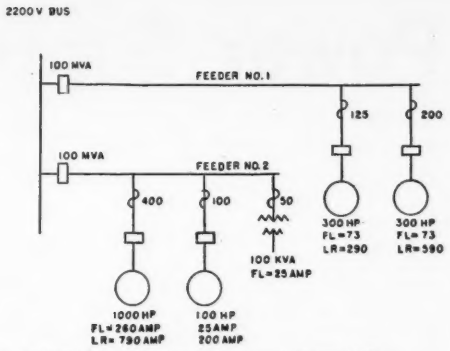


Fig. 3. Industrial Distribution Circuit—A Paper Mill

generally provided with differential protection relays which requires both high and low tension switching. High tension switching is also required to shift load from one transformer bank to another or to connect the transformer to a different incoming line.

Returning now to the generating station we have a 66 kv loop circuit serving a heavily industrialized area within a close radius of the generating station. On this circuit fuses provide ideal system protection by isolating small power transformer banks located at the numerous small industrial plants as at "E". At the larger industrial plants when continuity of service is of importance and more than one bank of transformers is used breakers would be required for switching purposes. Fuses would be used to advantage for the protection of potential transformers for power company metering. At location "G", there is a 2000 hp pumping plant for a petroleum pipe line. Here, as at the small industrial plants, economics dictate the use of high tension fuses for system short circuit protection. For such applications the current rating of the fuses must be selected with great care as the load is not diversified and all pump motors may be started simultaneously with a resulting inrush current that may be as high as 1000 per cent of continuous load current.

Protection of Metropolitan Distribution System

In Fig. 2 we have a metropolitan distribution system. In addition to locally generated power, incoming lines provide additional capacity. The buses are so segregated that ½ million kva feeder breakers are required. To ensure continuity of service and operate a low voltage secondary network, parallel feeders from different buses are used. Frequently there are spot loads of high capacity requiring higher voltage than can be supplied from the secondary network. Since one or the other feeder may be out of service it is necessary to provide changeover switching facilities. High interrupting capacity fuses connected to each feeder provide economical system short circuit protection with a non-automatic breaker or load-break disconnect switch to provide means for changeover. Since most installations of this nature are owned and maintained by the customer, the addition of power fuses by the power company will ensure system protection in event of inoperative customer's protective equipment. As such installations are generally indoors, the fuses should be of the dry type and totally enclosed to eliminate noise on operation and omission of flame or ionized gases. In connection with load break disconnecting switches now being widely used together with fuses for such applications it should be pointed out that such load break switches should generally be enclosed in a grounded steel enclosure or operated with a remote control mechanism. Since the load break switch is designed and intended for opening load currents, it is also possible to open or close in on a short circuit. Hence, the above recommendation to provide the maximum protection to the operator. High interrupting capacity fuses can also be used for the protection of small transformers in suburban substations and for protection of constant current street lighting transformers in larger substations.

Industrial Plant Protection

Fuses fit into industrial power distribution when there are numerous motors of such capacity that they must be operated at 220 v or above. An example would be a paper mill, Fig. 3, where there are a large number of motors ranging from 75 hp to as high as 3000 hp operating all sorts of saws, chippers, grinders, pumps, beaters, etc. In such an installation the extreme humidity and presence of various corrosive gases in the atmosphere cause frequent insulation failures in cables and motor windings. Since a large percentage of the motors are of the synchronous type, conventional motor starters of adequate interrupting capacity do not provide the requisite continuity of service. The low voltage on the feeder during a fault which persists for 8 cycles or more will cause the undervoltage relays to open the starters on all other motors on the feeder.

Dry type high interrupting capacity boric acid fuses have been used for a period of approximately 10 yr to improve operating conditions on such circuits. A set of such fuses is connected between each motor starter and the feeder to provide extremely rapid isolation of faults in the motor starter or motor windings. The fuses are so selected as to withstand the starting inrush current of the motor, hence do not operate on overloads. The starter provides this protection as well as switching operations. Since this type of fuse permits full short circuit current to flow, the starting contactor must be mechanically strong enough to withstand this current. This generally results in a starter having an interrupting capacity equal to the short circuit capacity of the bus. The additional expense of providing fuses to supplement this starter is justified by the results obtained by the high speed, generally one-half cycle, clearing of the fuses. Damage due to burning at the point of fault is reduced in approximately a direct ratio of the clearing times. Mechanical stresses on cables and windings is also reduced. System stability is greatly increased due to the short duration of voltage dip associated with short circuit. An example of this type of application would be on the control for the 1000 hp compressor motor. Since the motor has a full load current of 260 amp, current limiting type fuses cannot be used as they are available only in ratings up to 200 amp continuous. To withstand starting inrush of 790 amp for approximately one minute a 400 amp fuse with a minimum melting current of 880 amp in 10 minutes would be selected.

Fuses for Motor Starting

Current limiting type power fuses have recently been developed for motor starting applications. Since fault currents permitted by the fuse are limited to a small fraction of the available short circuit current, the starter does not need to be as strong mechanically as would be required with non-current limiting fuses. Motor starting contactors have been developed for use with current limiting fuses so that the combination has a three-phase interrupting capacity of 150,000 kva instantaneous symmetrical at 2500 v and 250,000 at 5000 v. The current limiting action of fuses further enhances the advantages given previously for using fuses as short circuit protective devices on motor starters. It is recommended that the starter with current limiting fuses be applied as a complete unit in

(*Continued on Page* 126)

Power Supply for the Geneva Steel Plant

Part II

Principal electrical features of power plant for supplying electricity and blast furnace air to new Geneva Works now being operated by Geneva Steel Co., U. S. Steel subsidiary, for Defense Plant Corporation, just completed at Geneva, Utah . . . Separate switch house . . . Central load dispatching system, first in steel mill history . . . Power generated and transmitted at 13.8 kv to mill substations . . . Part I of this article* described the steam and electric generating equipment and other mechanical features of the plant

By G. A. Gaffert and S. L. Chapin **Sargent & Lundy, Chicago, Illinois**

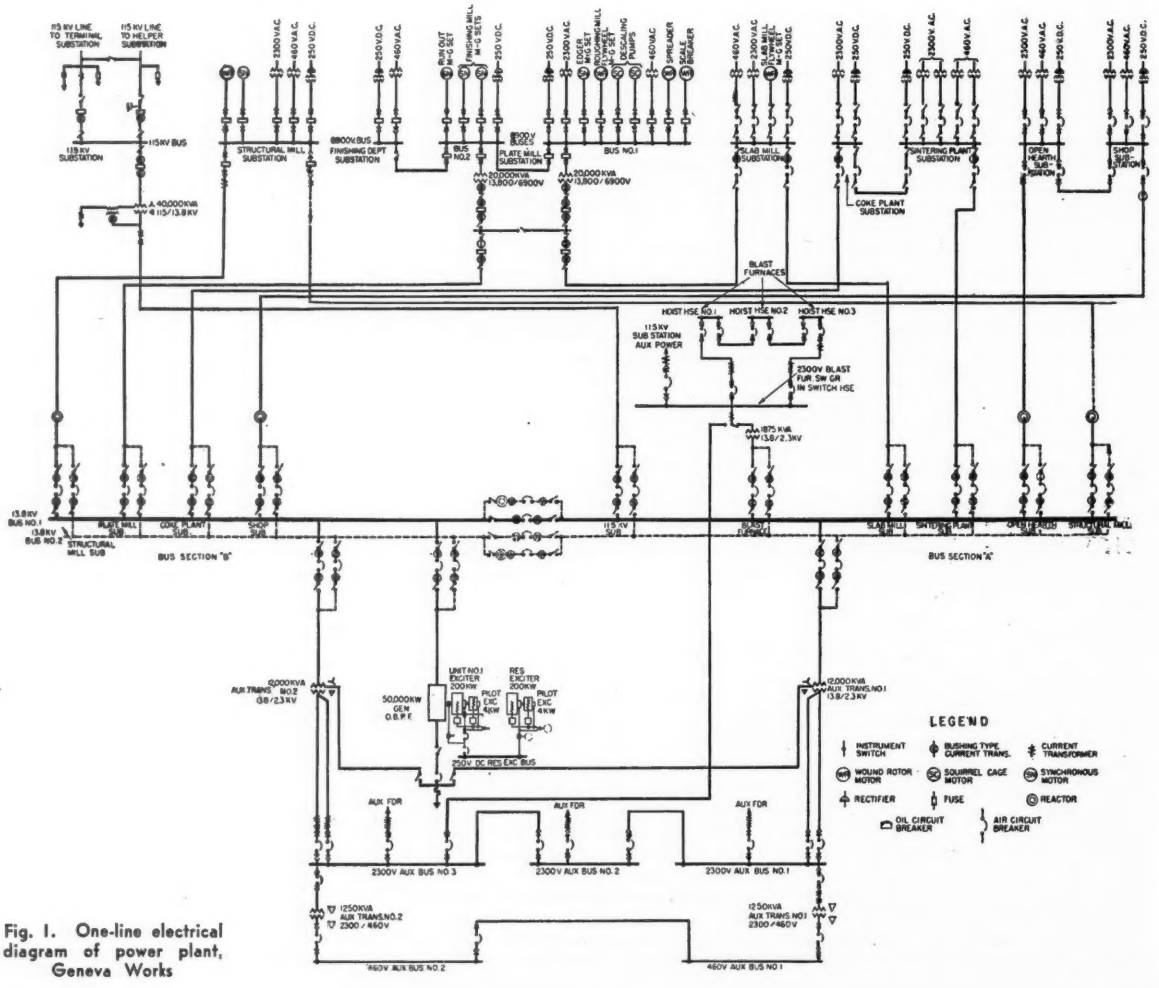


Fig. 1. One-line electrical diagram of power plant, Geneva Works

Switch House

THE 13,800-v generator and feeder switchgear and buses are installed in a two-story switch house separate from the generator and boiler plant. The building is of concrete and brick construction without windows and is equipped with a positive ventilating, cooling and heating system of the thermostatic type. One end of the building is occupied by the main control and load dispatcher's rooms, station battery room and offices. The switchgear rooms occupy the remainder of the building.

All 13,800-v switchgear in the switch house is the electrically controlled, pneumatically operated, metal-enclosed air-blast type rated 1,000,000-kva interrupting capacity. Each switchgear bus section is installed in a separate room on the second floor of the switch house. Potential transformers, feeder reactors and cable terminal compartments for the outgoing underground feeders are located on the first, or ground floor. A metal clad group of 2300-v air circuit breakers for controlling the feeders to the blast furnace plant is also installed on this floor.

Feeders are protected by pilot wire relaying, and differential protection is installed on the buses.

Two 250-v batteries are provided, one for control purposes, and the other for the operation of motor driven valves in the power station. Switching arrangements permit either battery to supply both systems in emergency.

Control and metering panels are of the steel cubicle type and are arranged in two parallel rows in the control room. Control switches and indicating instruments are mounted on the fronts of the cubicles and protective relays on the hinged rear panels.

All 13,800-v breakers in the switch house are operated by direct control from the panels in the control room and an extensive supervisory control system is provided for remote operation and control of equipment in the main distributing substations and mill motor rooms.

Supervisory operating and indicating devices for the control of equipment in each substation and motor room are located on the same panel, on which are mounted the direct control switches and indicating instruments for the 13,800-v breakers controlling the feeder to that substation. Due to the large number of supervisory functions required for the rolling mill equipment, several supervisory panels are necessary in some cases for each motor room feeder.

A separate load dispatcher's board is located in a room adjoining the control room. This board consists of three vertical sections, on the center one of which are mounted recording watt meters and var meters for the generator, transformer and 13,800-v feeder circuits. On this section is also installed a frequency controller designed for automatic control of the system frequency as well as load and tie line control.

On the two end sections of the board are mounted gas, steam, and water recorders for recording quantities of these items as measured at numerous points throughout the plant. The measuring devices at metering points are equipped for transmitting the readings by telemetering to the recorders on the load dispatcher's panels.

Auxiliary Power Supply

Auxiliary power for the turbo-generator set, boiler, and other station auxiliaries is provided by two 12,000-kva, 13,800/2300-v, 3-phase transformers, each fed from a separate section of the main 13,800-v bus. The low voltage side of each transformer is connected to a group of 2300-v metal-clad air circuit breakers located in a switch room below the fan floor in the boiler room. A third switch group is provided which can be connected to either main group.

Two 1250-kva, 2300/460-v, 3-phase transformers, each served from a separate 2300-v bus, supply two sections of 460-v metal-clad air circuit breaker switchgear.

Power and control cables are installed in sheet metal cable pans throughout the power station and switch house instead of in individual iron conduits. All cables for 2300-v service and less have varnished cambric insulation and lead sheath with a protective wrapping of fire resisting tape overall.

Motors of 100 hp and less are rated 440 v and are totally enclosed, fan cooled, ball bearing with Class "B" insulation. Motors larger than 100 hp are rated 2300 v and have drip-proof frames or drip covers and ball bearings, but are built with Class "A" boiler house insulation.

*Part I, July issue, page 20. For detailed discussion of reasons for building the steel mill at Geneva, construction details and general operation of the mill, see Utah Now Producing Steel, by C. H. Vivian, Compressed Air Magazine, February, 1944. For data on the way in which all steel mill electric power supply and distribution systems are controlled from a central point, see Supervisory Control for the World's Most Modern Steel Mill, by P. B. Garrett and M. E. Reagan, presented before AIEE, December, 1943, at New York.

Principal Electrical Equipment, Power Plant, Geneva Works, Geneva Steel Co.

ELECTRICAL EQUIPMENT IN SWITCH HOUSE

13,800-v Switchgear	Westinghouse E. & M. Co.
Construction	Metal Enclosed
Air Circuit Breakers	
Type	150-CA-1000
Ampere Rating	1200 and 3000 amp
Voltage Rating	15,000 v
Interrupting Capacity	1,000,000 kva
Operation	Electrically controlled, 250 v, d-c, pneumatically operated, with air blast break.
2300-v Switchgear	General Electric Co.
Construction	Metal Clad Type MI
Air Circuit Breakers	
Type	AM-5-100
Ampere Rating	600 amp
Voltage Rating	5000 v
Interrupting Capacity	100,000 kva
Operated by	Solenoid—250 v d-c
13,800-v Feeder Reactors	Metropolitan Devices Corp.
Number	4
Type	3 phase—60 cycle
Ampere Rating	500 amp
Voltage Rating	13,800 v
Kva Rating	358.5 kva
Reactance	3 per cent
Resistance	0.479 ohms
Volts Drop	239 v
Enclosure	Transite
Control and Supervisory Panels	Westinghouse E. & M. Co.
Construction	Cubicle Type. Stationary front panels, hinged rear panels.
Instruments	Flush Mounted
Supervisory Equipment	Visacode
Voltage Regulators	G. F. A.—General Elec. Co.
Battery Control & D. C. Distr. Panels	Westinghouse E. & M. Co.
Construction	Cubicle Type
Air Circuit Breakers	Hand Operated
Load Dispatching Panels	Leeds & Northrup Co.
Construction	Vertical, open
Recorders	Micromax, Flush mounted
Load & Frequency Control Equip.	Proportional Step Type
Control Batteries	Gould Storage Battery Co.
Number	2
Type	NPE-415, Plante
No. of Cells	120—250 v
Capacity	35 amp—8 hr
Battery Charging Sets	Electric Products Co.
460-v Aux. Switchgroup	I. T. E. Circuit Breaker Co. Hand and Electrically operated air circuit breakers in cubicle type enclosure.
Lighting Distribution Group	I. T. E. Circuit Breaker Co. Hand operated air circuit breakers and automatic transfer switch in cubicle type enclosure.
Telephone Equipment	Automatic Elec. Sales Co. P. A. X.: 50 position, with code call equipment.
2300-v Transformer	Allis-Chalmers Mfg. Co.

List of Equipment
Continued on Page 82

Principal Electrical Equipment, Power Plant, Geneva Works, Geneva Steel Co.

(Continued from Page 81)

ELECTRICAL EQUIPMENT IN POWER STATION

Motor Driven Exciter	General Electric Co.	
Number	1	
Type Motor	K, 3 phase, 60 cycle	
Hp Rating	200	
FL rpm	1180	
Voltage	2300	
Generator	Main	Pilot
Type	Shunt Wound	Comp. Wound
Kw Rating	200	4
FL rpm	1180	1180
Voltage	250	250

2300-v Aux. Power Transformers	Westinghouse E. & M. Co.
Number	2
Type	SL—3 phase 60 cycle
Voltage Rating	13,800/2300 v
Kva Rating	9000 kva (12,000 kva—forced air).
Connections	Wye-Delta
Neutral	Grounded through Resistor
460-v Aux. Power Transformers	Westinghouse E. & M. Co.
Number	2
Type	SL—3 phase, 60 cycle
Voltage Rating	2300/460 v
Kva Rating	1000 kva (1250 kva—forced air).
Connections	Delta-Delta
Lighting Transformers	Allis-Chalmers Mfg. Co.
Number	2
Type	OISC—1 phase, 60 cycle
Voltage Rating	2400/240/120 v
Kva Rating	150 kva
2300-v Aux. Power Switchgear	General Electric Co.
Construction	Metal Clad Type M16 Vert. Lift
Air Circuit Breakers	
Type	AM-5-150
Ampere Rating	1200 and 2000 amp
Voltage Rating	5000 v
Interrupting Capacity	150,000 kva
Operated by	Solenoid—125 v d-c

460-v Aux. Power Switchgear	I. T. E. Circuit Breaker Co.
Construction	Metal Enclosed
Circuit Breakers	
Type	K.B.—Drawout
Ampere Rating	225 to 1600 amp
Voltage Rating	600 v
Interrupting Capacity	25,000 amp
Motor Control Circuit Breakers and Linestarters	Westinghouse E. & M. Co.
Generator Neutral Air Circuit Breaker	Westinghouse E. & M. Co.
Construction	Metal Enclosed
Air Circuit Breaker	
Type	150-U-12—1 pole
Ampere Rating	1200 amp
Voltage Rating	15,000 v
Interrupting Capacity	250,000 kva
Operated by	Solenoid—250 v d-c
Generator Neutral Resistor	Westinghouse E. & M. Co.
Type	Cast Iron Grids
Ampere Rating	2000 amp—one minute
Voltage Rating	15,000 v
Ohms Resistance	4 ohms
Lighting Distribution Switchgroup	Westinghouse E. & M. Co.
Construction	Metal Enclosed—Cubicle Type.
Air Circuit Breakers	Type DA-50 and AB, Hand Operated.
Generator Field Breaker	Westinghouse E. & M. Co.
Construction	Metal Enclosed—Cubicle Type.
Air Circuit Breakers	
Type	DA-50
Ampere Rating	1500 amp
Operated by	Solenoid—250 v d-c
Generator Fire Protection Equipment	Walter Kidde Co.
Type	Automatic CO_2

ELECTRICAL EQUIPMENT IN 115-KV SUBSTATION

138-kv Oil Circuit Breakers	Westinghouse E. & M. Co.
Number	3
Type	GO-2A, T. P. S. T.
Voltage Rating	138,000 v
Ampere Rating	600
Interrupting Capacity	1,500,000 kva
Operated	Pneumatically closed, electrically tripped.
Potential Devices	115,000/115 v one on each of two line O.C. Breakers.
Power Transformers	Allis-Chalmers Mfg. Co.
Number	3
Type	OISCO-FA—1 phase—60 cycle.
Kva Rating	10,000 kva (13,334—forced air)
Voltage—Primary	66,397 (115,000 v Wye)
Voltage—Secondary	13,800
Taps	2—5 per cent taps above and below normal.
Connections	Wye—primary, Delta—secondary.
Neutral	Solidly grounded
Insulation	H. V. Winding and Bushing—138 kv.
Potential Transformers	Westinghouse E. & M. Co.
Current Transformers	Westinghouse E. & M. Co.

Regulating Transformer	Allis-Chalmers Mfg. Co.
Number	1
Type	OISCTO-FA-TLK—3 phase—60 cycle.
Kva Rating	4000 kva (F. A.)
Max. Regulating Volts	6640/11,500 v
Exciting Volts	13,800
Regulating Range	10 per cent raise or lower from normal.
Connections	Connected in neutral of power transformer bank.
Disconnecting Switches	Railway & Indus. Eng. Co.
Number	7
Type	TTR—3 pole single throw
Voltage Rating	161,000 v
Ampere Rating	600 amp
Operated	Group-manual
Lightning Arresters	Westinghouse E. & M. Co.
Number	2
Type	5 v—3 phase
Voltage Rating	121 kv line to ground
Structure	Railway & Indus. Eng. Co.
Type	Wood frame—Hughes Bros.
Carrier Current Equipment	Westinghouse E. & M. Co.
Control and Supervisory Panels	Westinghouse E. & M. Co.

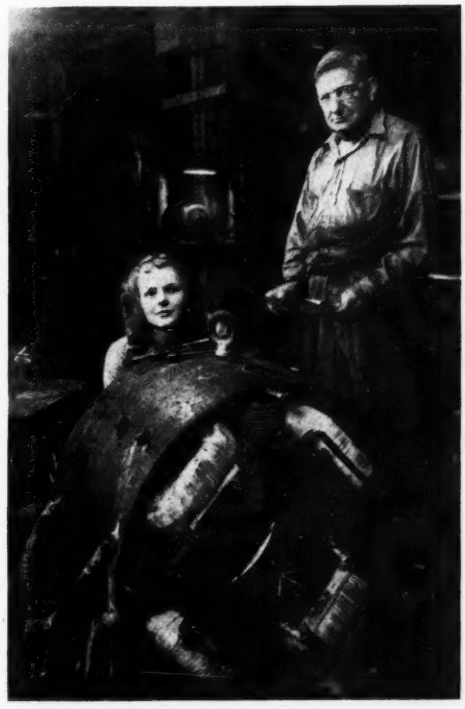
MISCELLANEOUS ELECTRICAL EQUIPMENT

Motors	General Electric Co.
Hp Ratings above 100 hp	2300 v, squirrel cage, induction with protected frames, sleeve bearings and Class A insulation.
Hp Ratings 100 hp and less	460 v, squirrel cage, induction totally enclosed, fan cooled, ball bearing, Class B insulation.
Power Cable	American Steel & Wire Co. Anaconda Wire & Cable Co. General Cable Co.
13,800-v Service	3/c—350,000 cm, 15 kw, paper insulation sector type, shielded, with lead sheath.
2,300-v Service	5 kv, varnished cambric insulation, with lead sheath.
460-v Service	2 kv, varnished cambric insulation, with lead sheath.
250-v, d-c Service	2 kv, varnished cambric insulation with lead sheath.

Supervisory and Telemetering Cable	Graybar Electric Co. No. 16 ga conductors, paper insulation, lead sheath.
Cable Terminals	Delta Star Elec. Co.
Cable Pans	Central Architectural Iron Works.
Fire Alarm Equipment	The Gamewell Co.
Lighting Equipment	
Open Hearth High Bay Fixtures	Westinghouse E. & M. Co. —750—1000 w Millite.
Rolling Mill High Bay Fixtures	Westinghouse E. & M. Co. —3000 w Mercury Vapor.
Power Station	Holophane Prismatic

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR



LAURA—Electrician, First Class

The "Wizzard" at Dan Gutleben's Pennsylvania Sugar Plant in Philadelphia made an innovation in the electric shop when he added Laura to his gang to replace a fighting man. While she was standing at attention awaiting her first orders, the riggers brought in a 200 hp motor. The "Wizzard" who in private life is Herman Dost, Chief Electrician, told the foreman to move it to the repair bay. Straightway, Laura put her hands under it and started to heave . . . **(Continued on page 85)**

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

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Learning the Hard Way

By R. L. BROWN

This account should bring back the old days for many engineers who came up the hard way. Only those who spend long days and weary nights fixing up and keeping old and neglected boilers and engines running can fully appreciate the endlessness of the work in small plants such as the author describes. Mr. Brown wrote this account as a result of our appeal for material on small plants in the April issue. How many other readers have had similar experiences? Remember, if you find this account interesting, others will be just as interested in yours. We can all learn something by exchanging experience

LIKE a lot of other engineers, I am interested in the small power plant's care and operation. I, for one, haven't the college education to ever get into one of those large power plants where they generate 50,000 kw per hr, and, probably, will be fortunate indeed if I can ever feel equal to a 10,000 kw job.

No doubt there are thousands of engineers in this country who, like me, started in at passing coal and wheeling ashes, perhaps doing one or two other jobs besides, just to learn. The wages for this kind of work have never been high in comparison to those paid in other crafts and trades, so if a fellow doesn't have that college education to start with, he has to work up the best way that he can. This way of learning the game is pretty hard and one is liable to make a good many costly mistakes before he can qualify as a chief power plant operator.

Maybe some of the mistakes made at one small power plant of about 600 bhp might be of some interest to readers of POWER PLANT ENGINEERING. I will try to explain these, and thus pass on some of the information that I learned the hard way while working as a shift engineer at this particular plant.

In the first place the plant was overloaded to the stretching point. All of the four boilers were of the hrt type with Dutch ovens for burning hog fuel, shavings, slack and sawdust. The largest of these boilers was a 6 ft by 18 ft with 72—4-in. tubes and the smallest was 5 ft by 16 ft with 44—4-in. tubes. As the boilers were the cause of most of our troubles, I will try to explain some of our difficulties with them.

First, the feedwater ran a good average of hardness and it seemed that the plant manager could never be convinced that we were in need of a good boiler compound or a water conditioner. He always said that, "there wasn't any difference in boiler compounds" and that a water softener would be too expensive.

Feedwater Troubles

The water was taken from a small creek that emptied into the log pond. In the early spring and winter time the water was rather clean but during the summer months the water became quite brackish, the logs being white fir, pine, and spruce left a sour smelling solution in the pond and did this water foam! It went through the packing joints just like so much soapsuds. However, when the load was not too heavy it did not foam so badly but by the end of the week we used to lose from an hour or two a day, running slow motion, while the boilers were being blown down. I expect that some of the fellows will wonder why the management didn't do something about it. Well, I wondered myself at the time. They did, however, dig a well near the pond. This well supplied about half enough water.

Finally after three summers of fiddling around in this fashion, and losing several thousand dollars due to lack of production, the management did what the chief engineer wanted them to do in the first place. That was to build a concrete dam about 100 yards upstream from where the small creek ran into the pond. This prevented the sap-stained water from backing upstream.

This made the suction line too long for the boiler supply tank pump, so a steam line was run up to the dam and the pump installed there. This worked O.K. when the chief finally got the thing to work. At first one of the operators had to make a trip up to the pump to get it started. The steam varied between 80 psi and 135 psi about every 30 min. This was due to our heavy overload and possibly, the heavy scale that covered the tubes. Well, when the pressure would drop, the pump would stop and when the pressure was up to top, if the pump was running, it would be making some 90 odd miles per.

After a while the chief convinced the boss that he needed a pressure regulating valve, for the pump. He used an old "pop" from the low pressure discharge side of an old cross compound Corliss. He then set the pressure reducing valve to run at 75 lb and he installed an overflow on the boiler room tank, thereby allowing the pump to run continuously. This set up worked fairly well, for which I was grateful, as most every time I went up to where the pump was, that blasted whistle would blow for the mill to stop; then I would have to run back at the best speed that I was capable of, to try and catch the big Corliss before the fireman got her on center, as pulling that old engine off from the middle was no small task. Maybe the job would not have been so difficult if the chain blocks that we had to use had been in good repair.

This particular engine was a 20 by 36 in. double eccentric Allis-Chalmers machine. There was no control over the exhaust valves. The clutch for hand starting was on the steam eccentric only. We had to give her a boost with the throttle cracked just before center, otherwise it had a habit of hitting center. This engine used to pound pretty badly, too. It seems that the man who first installed this engine forgot that there was such a thing as correct alignment.

As this engine ran non-condensing, exhausting to the atmosphere, it used considerable steam per bhp hr. After we had operated it for some time, the chief grew tired of this pounding and puffing. He asked me if this engine had always been this way and for all I knew it had.

We Went to Work in the Fall

The chief went to work that next fall when the plant shut down for the winter. First thing we did was to strip the engine of everything, including the flywheel, and drive shaft. We then proceeded to tie the outboard bearing pedestal and the main engine foundation together with reinforced concrete. As the outboard pedestal bearing had been moving under heavy loads, a bucket full of water could be placed upon the concrete and it would spill over from the movement.

Next, we melted old metal from all of the bearings with an acetylene torch. Then a line was run through the bore coinciding with the crank line at 90 deg with the shaft. We found the pedestal bearing to be high, about ¼ in. and shifted towards the crank end about the same distance; so, we had to take the pedestal bearing up and do some chipping on the concrete. We chipped down below the grouting about six inches, then shifted the bolts and reset the bearing to the correct alignment, which we found by using a precision line level, a pair of calipers and a set of tram points. Using six feet as our guide mark for the tram points, and after making all necessary adjustments, we built our form for the concrete. We poured the concrete and allowed it to set about three days.

We did not have any other means available such as a lathe, nor the necessary time to make a jig to bore our bearings, because the management had suddenly decided to make an early start. So we lowered the drive shaft into the bearing shells and poured our bearing metal around the shaft. We were careful to keep as close as possible our original bore alignment and cross elevation.

We had to raise and lower the shaft a couple of times as we metalled the quarter boxes on the shaft too. We got along nicely until we came to the top bearing on the crank end. This was difficult but we finally succeeded after losing the metal a couple of times. We also poured the crank brasses and we

were lucky enough to get a new wrist pin and a set of brasses from the factory.

This engine had six 90 deg elbows in its exhaust line. We managed to eliminate four of these. This was a six inch exhaust. The original specifications called for a ten inch exhaust and a seven inch feeder steam line. This engine had straight six inch steam and exhaust lines with no steam trap or separator. The chief dug up an old Crane, bucket trap and steam separator from somewhere. We repaired these and installed them.

We also put a quill in the oil line where, before, there had been only a bushing fitted to the six inch steam line and a single feed hydrostatic hung to it. We replaced this with a Manzel force feeder pump.

In a couple of weeks we had the Corliss ready to reassemble to see if we had accomplished anything. We also had the steam chest sent to a machine shop, valve seats rebored and fitted with new valves, piston rings and rod, as the before mentioned foaming of the brackish water in the boilers had raised Cain when it carried over into the steam. With no steam separator or trap to eliminate any of the carryover, the engine had to take it all. It didn't take much of this carryover to wash off what little oil there was on the valve seats and cylinder walls.

The chief reset the eccentrics and the valve as accurately as possible before we put the belt on to make the first trial run. He also had an indicator.

The Engine Is Started

Well, the morning finally came to start up. We turned her over slowly for about an hour to get the bearings seated and everything loosened up a bit. Then we gradually opened the throttle and put on the load. It was not long before we were all busy as the bearings began to warm up; it seemed, we had them a little tight. We loosened the bearings and allowed them to pound a little for the rest of the day. The next day we gradually took them up. We ran the engine this way for about a week until we had it running pretty sweet. This working over seemed to help a lot as the engine no longer dragged down when big logs were being sawed in the mill. This job made the fireman happy too.

The chief put the indicator on the next week and he obtained a pretty fair card. He had to advance the exhaust eccentric a little to get a little more compression and shorten the lap a little on the head end steam valve.

Since that time this engine has received better care and has never been allowed to be neglected and, although 15 years have passed, it is still running sweetly. I don't believe that there has been much lost time charged to the engine, since. However, the boilers at this plant are still giving trouble because of heavy scale. The same old system is being used in regards to the feedwater. The management has spent many thousands of dollars replacing tubes and repairing their blistered boilers.

Perhaps, sometime the management will decide to modernize their plant with the installation of water tube boilers, turbines, etc., but if they do I'll bet that they also will have to do something about the feedwater.

Tojo's Little Helper

By HAROLD S. SYKES

YES, there's work that could be done,
Fix that pump an' make it run,
Replace some grates an' line a firebox,
Sweep the floor an' fix some locks,
Use a soot blower and an oilcan,
Use a paint brush, break in new man.
But the boss ain't watchin' me,
I'm irreplaceable; someday he'll see.
He says my wages is froze;
That's just an excuse, don't you 'spose?
He says, "Let's all jump in this fight
And we'll win the war all right."
But he can't fool me with that;
I know my rights an' where I'm at.
He's so busy that he don't know
I come to work late—an' slow.
I can loaf where he can't see,
He ain't putting nothing over on me.
Why should I rush around 'till I die?
Is extra work noticed? In a pig's eye!
So I'll mark time 'till I get more pay,
WHAT? I'm fired? Effective today!

Laura—Electrician, First Class

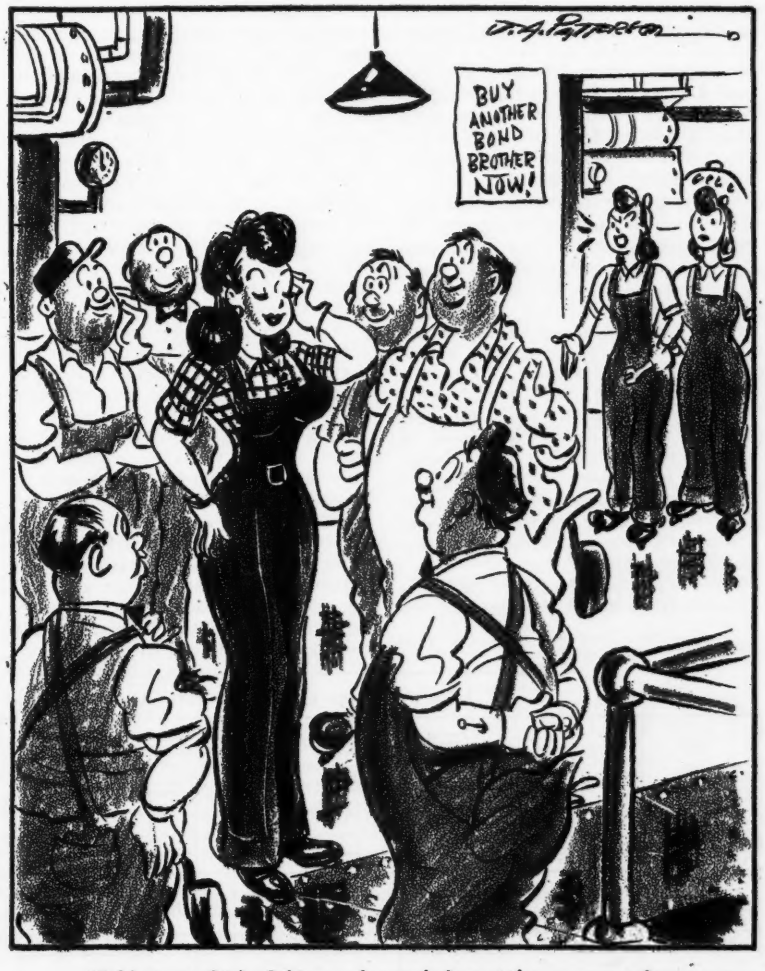
(*Continued from page* 83)

She found that a 2-ton motor does not respond readily to the lifting power of a 125-lb girl! In a few days, however, she acquired the art of being a helper and then proceeded to the task of winding armatures.

Her eagle eyes miss nothing and she watches the mechanics to administer to their needs. When she notices a mechanic with flopping cuffs, she insists on sewing on a button. During a lull between jobs she gets a bucket and washes windows. The shop floor is now spic and span. Some fellow carelessly spit on the floor. Immediately she demanded, "Who did that?"

An unexpected advantage is reported by the Wizzard. Receiving Clerk, Joe, now makes prompt personal deliveries of packages to the electrical shop whereas, formerly, he used to call up and tell the Wizzard to come and get them.

At home, Laura is the mother of a little daughter who is left under the care of grandmother. Her husband is building ships to fight the Japs with.



"I'd hate to think of the man hours she's cost the company since she's been here."

Boiler Fireman's Handbook

By J. R. DARNELL

This is the first of a series of articles on firing and combustion to be written by Mr. Darnell. These articles, each one of which will constitute a chapter in what may be called the boiler fireman's handbook, will be elementary in character and aimed especially at the boiler room operator. This first article considers the fundamentals of combustion. The second one will tell why flue gas temperature goes up when the CO_2 goes down. A third article will deal with flue gas sampling and analysis, others with burning particular fuels

I. Fundamentals of Combustion

THE COMBUSTIBLE CONSTITUENTS[1] of all fuel, whether coal, coke, lignite, wood, oil or gas are two substances or elements known as carbon and hydrogen. When solid fuels burn, a certain portion of the carbon and the hydrogen which are in combined form, are distilled off as gases known as hydrocarbons. Some free hydrogen is also given off. These gases ignite at or near the surface of the fuel bed.

In its commonest form carbon is a hard black material and in its pure state is difficult to burn. The electrodes used in arc lights, the so-called "lead" in a pencil, and the center post in an ordinary dry cell are common examples of carbon. Thoroughly dry petroleum coke which has had almost all of the oil driven off, is almost pure carbon and is difficult to ignite.

Hydrogen, in its free state, is a very light gas which ignites very easily and when mixed with air in the proper proportion is very explosive. Since a given weight of hydrogen when burned, produces more heat than an equal weight of any other substance, a fuel which contains a high percentage of hydrogen has a high heat value.

In the United States and other English speaking countries, the heat value of fuels is expressed in terms of British thermal units. One British thermal unit (abbreviated as Btu) is the amount of heat which will raise the temperature of one pound of water one degree, measured with the Fahrenheit thermometer.

When one pound of pure carbon is completely burned, 14,600 Btu are produced. One pound of hydrogen when burned produces 62,000 Btu.

The amount of carbon in coal may vary from 50 to 85 per cent, but the hydrogen in most coals, regardless of the quality of the coal, varies in a very narrow range i.e. from about 4.75 to 6 per cent. Almost all boiler firemen are familiar with the term "CO_2" and are aware that the percentage of CO_2 (chemical symbol for carbon dioxide) in the waste gases leaving the boiler, is a guide to proper firing. The percentage of carbon and hydrogen in any fuel has an important bearing on the CO_2 value which a fireman should try to obtain when firing any given fuel.

Air or oxygen is required to burn any fuel. Air contains 21 per cent oxygen and 79 per cent nitrogen by volume. Nitrogen is an inert gas and has no effect on the burning of fuel, but its presence must be considered when calculating the volume of carbon dioxide and other gases produced when a given weight of fuel is burned with a given volume of air.

If it were possible to fire a fuel composed of pure carbon only (no hydrogen present) and if the exact volume of air necessary to burn this carbon were admitted to the furnace in such a way that it would be so intimately mixed with the carbon that only this exact amount of air would be needed to completely burn every particle of carbon, a CO_2 recorder or a hand Orsat (flue gas analyzer) would show 21 per cent CO_2 in the products of combustion, assuming no air leakage into the furnace.

If this same intimate mixing could be done, for example, with bituminous coal, with no extra amount of air left over, the CO_2 recorder or indicator would show approximately 18.6 per cent CO_2. The maximum theoretical CO_2 which can be obtained under ideal conditions with coal firing is lower than with pure carbon because of the presence of about 5½ per cent hydrogen. Some of the oxygen in the air must be used to burn the hydrogen. When hydrogen burns, that is, unites with oxygen, it forms water which, in the form of vapor is intermingled with the carbon dioxide and nitrogen in the fuel gas. When a sample of flue gas is drawn off from the boiler setting in order to measure the CO_2, by the time the flue gas sample reaches the CO_2 recorder or Orsat the water vapor formed by the burning of the hydrogen in the fuel, condenses and drops out of the volume of gas which is recorded as CO_2.

The Meaning of Excess Air

Since it is not possible, under actual operating conditions, to provide the exact amount of air to burn the fuel and yet not have any air left over, the amount of air which remains is called "Excess Air." This can be determined either by a measurement of the CO_2 in the flue gas or by measuring the oxygen. The former is more commonly used. In a subsequent chapter, simple formulas will be given to show how to calculate the maximum theoretical CO_2 for a given fuel and the percentage of excess air corresponding to the actual CO_2. A comparison of the

[1]For practical purposes, sulphur in most fuels need not be considered.

[1]In the July issue, page 114, we published a chart showing excess air percentages and furnace temperature values for various percentages of CO_2 from zero to the maximum theoretical. This chart was taken from material originally supplied by Joseph W. Hays.

J. R. Darnell has called our attention to errors in these curves, pointing out that there is no commercial fuel capable of producing a maximum theoretical furnace temperature of 5000 F corresponding to 20 per cent CO_2. Mr. Darnell states that any fuel having a maximum CO_2 of 20 per cent will have a heat value in the range where an attainment of 5000 deg furnace temperature is impossible. Fuels such as wood, bagasse, coke breeze and anthracite fines, which have maximum CO_2 values in excess of 20 per cent have heat values below 10,000 Btu and their maximum furnace temperatures are generally below 3800 deg. As a matter of fact, he says there is no fuel which can be burned with air at room temperature, which will produce 5000 deg except pure hydrogen. Eastern bituminous coal, which has the highest carbon content of any coal (14,300 to 14,600 Btu as fired), has a maximum theoretical CO_2 value of about 18.7 per cent with zero excess air. This corresponds to a flame temperature of about 4000 deg. There is a definite CO_2—excess air and furnace temperature relationship for every type and class of fuel and serious error will result in attempting to place all fuel under one classification.

Table I. Average optimum per cent CO_2 and excess air for firing methods shown below

Kind of Fuel	Max. Theoret-ical	Hand Firing		Natural Draft Chain Grate		Forced Draft Chain Grate Stoker								Forced Draft Under Feed Stoker		Pulverized Bituminous Coal		Oil Burning		Gas Burning		Waste Fuels Modern Design Furnace and Grates	
						Lignite		Bit. Coal		Coke Breeze		Anthra. Fines											
	Percent	Percent		Percent		Percent		Percent		Percent		Percent		Percent		Percent		Percent		Percent		Percent	
	CO_2	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air	CO_2	Excess Air
Blast Furnace Gas	25.1																			30.0	55		
Wood Waste	20.5																					16.4	25
Bagasse*	20.4																					15.0	36
Anthracite Fines	20.2											14.3	40										
Coke Breeze	20.0									14.8	35												
Lignite	19.3					13.0	48																
Bituminous Coal	18.6	11.9	55	12.3	50			14.0	32					14.2	30	14.8	25						
Oil	15.4																	13.9	18				
Refinery Gas	13.3																			10.4	25		
Natural Gas	11.7																			9.2	25		

*Kiln Dried

actual CO_2 with the calculated theoretical value, tells us what percentage of excess air is being used. The greater the percentage of excess air, the lower the combustion efficiency. Of course, combustion efficiency should not be the sole goal of the fireman because he might be able, at times, to get exceptionally high CO_2, but his furnace temperature might be so high that he would burn up his grates or melt down the walls.

As stated above, the ideal, theoretical CO_2 percentage which can be obtained with coal firing is about 18.6 per cent but since it is not possible to obtain such a figure under practical operating conditions, the boiler fireman must set his sights on a figure somewhat lower. This will depend on a lot of other conditions such as the kind of firing equipment, the kind of draft, and the nature and design of the setting. Naturally, if a fireman gives close attention to a single furnace and boiler, without having to worry about others on the line, he can maintain a higher average CO_2 value than he can when he has 5 or 6 fires to watch. There is an optimum practical CO_2 value which should be maintained for every group of firing units. Experience must decide what this value shall be.

The Fireman's Goal

Table I shows the average theoretical CO_2 values which can be obtained with different kinds of fuels and the average optimum CO_2 and excess air values which should be maintained for the various types of firing. The average excess air values were taken from statements of various authorities on combustion, based on their experience with daily operating conditions.

It should be kept in mind that the CO_2 and excess air values given as representing best operating conditions are, more or less, the grand average of a large number of plants. Firemen in some cases will find that certain installations will permit higher CO_2 values than those shown or it may be that the values given are too high for good economy in the particular plant or unit under construction. The fireman should strive to maintain a balance between the most efficient and the most economical operation. If attempts are made to increase combustion efficiency beyond a certain point, incomplete combustion (CO) may result and the resultant increase in furnace temperature, due to decrease in excess air, may cause excessive furnace maintenance costs. In Table I it should be noted that the maximum theoretical CO_2 obtained in burning blast furnace gas averages 25.1 per cent. This is higher than that obtained with pure carbon because this gas contains from 10 to 12 per cent CO_2 before burning. The combustible constituents of this gas are carbon monoxide (CO) and hydrogen.

A Comparison of Metering Methods

By C. O. von Dannenberg

THE CONVENTIONAL methods for measuring 3-phase energy have been so well established that attempts at deviation or modification are of interest to indicate whether any inaccuracies are introduced of appreciable or negligible value.

The instance referred to concerns a transformer installation stepping down from 13,200 to 220 v, 3 phase, through a star-delta combination. As shown in Fig. 1, the supply input was metered in a conventional way, using two current and two potential transformers for meter M-1. The customer in attempting to provide a check metering installation proposed using two current transformers in the 13,200-v conductors but to take the meter potential directly from the 230-v leads. The physical connections are shown in Fig. 1 with the customer's meter indicated as M-2. All current and potential leads are indicated to show their relation to either M-1 or M-2.

The vector relations concerned are shown in Fig. 2 neglecting any consideration for the comparison. The effect upon the 230-v side of the regulation of the main bank which would of course increase any error through the regulation of the bank and power factor of the load.

From Fig. 2 it is clear we can write for 100 per cent power factor: (Assuming correct register ratios are provided in the meters.)

For the conventional method:

(1) $W_C = E_{CB}I_C \text{ Cos } 30 + E_{AB}I_A \text{ Cos } 30$

and for the proposed check method:

(2) $W_p = E_{DE}I_A + E_{FE}I_C \text{ Cos } 60$

Assuming changes in power factor in a lagging direction we can write for any power factor:

(3) $W_C = E_{CB}I_C \text{ Cos } (30-\theta) + E_{AB}I_A \text{ Cos } (30+\theta)$

and

(4) $W_p = E_{DE}\ I_A \text{ Cos } \theta + E_{FE}I_C \text{ Cos } (60-\theta)$

If we assume for clarification and simplicity that: $E_{CB}I_C = E_{AB}I_A = E_{DE}I_A = E_{FE}I_C$, then it is clear the values of W_C and W_p can never be the same with the connections as indicated. It is plain that the values of E_{DE} and E_{FE} would always be less than E_{CB} and E_{AB} hence the errors in the table given would be changed somewhat although these are not the major inherent shortcomings of the proposed method.

The range of lagging power factor given will probably cover the range met in practice and it is of interest to observe in the appended summary that the proposed method would incorrectly register for every value of power factor given, increasing rapidly with decrease in power factor. In only one instance, 100 per cent power factor, does the proposed method show a lower value than for the conventional method.

Comparison of Meter Registrations for Different Power Factor Values

Load Power Factor Lag Per Cent	Meter No. 1 Relative Registration Correct Method Element I	Element II	Total	Meter No. 2 Relative Registration Proposed Method Element I	Element II	Total	Ratio No. 2 To No. 1 Per Cent
100	0.866	0.866	1.732	1.000	0.5000	1.5000	86.6
90	0.562	0.997	1.559	0.9003	0.8271	1.7274	111
80	0.392	0.993	1.385	0.7997	0.9198	1.7195	124
70	0.2504	0.936	1.1864	0.7009	0.9681	1.6690	141
60	0.1201	0.9198	1.0400	0.6004	0.9928	1.5932	153
50	0.000	0.8660	0.866	0.5000	1.0000	1.5000	173

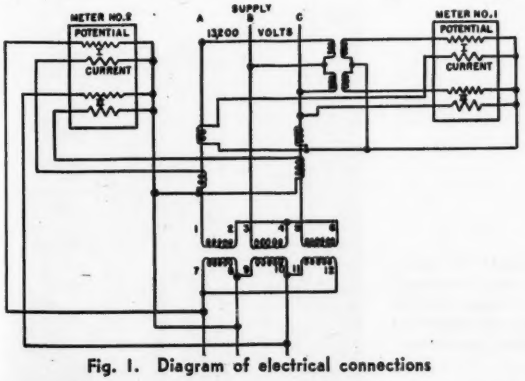


Fig. 1. Diagram of electrical connections

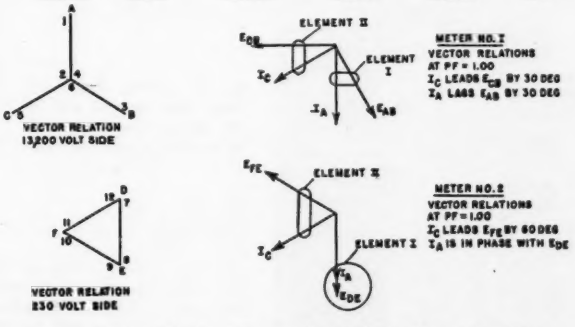


Fig. 2. Vector relations (The numbers indicate the ends of the transformer windings.)

HOW TO INSTALL POTHEADS

By T. H. MacCAULEY
Switchgear Division, General Electric Co.

In industrial distribution systems it has become common practice to run the small size feeders to load zones at high voltage (2500 to 15,000 v) and there at unit substations transform to lower utilization voltages, rather than to transform outside the station and run the large size feeders to the load at utilization voltages of 480 and below. This has meant a wider use of metal clad switchgear and unit substations, and, therefore, a greater need for information on the proper method of connecting high voltage cables to switchgear.

Potheads are recommended for such cable terminations. This pictorial sequence of connecting cables in potheads was posed and directed by General Electric Co. cable splicers with years of experience and great skill in the application of cable potheads.

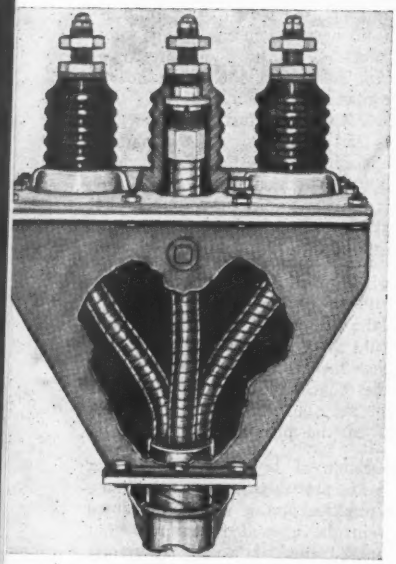


Fig. 1. (Left) Isometric view showing a 3-phase cable connected to a pothead for 13,800-v service. Note where the 3-conductor cable insulation ends, the lead sheath and how the single conductors are fanned out

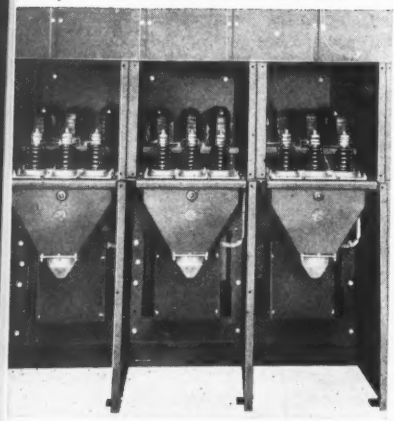


Fig. 2. (Left) Rear view of the two metal-clad units to show the potheads in place ready for disassembling and connecting of the cables

Fig. 3. (Left) The initial step: The tapered end of the wiping sleeve is cut off so it will slip over the cable freely

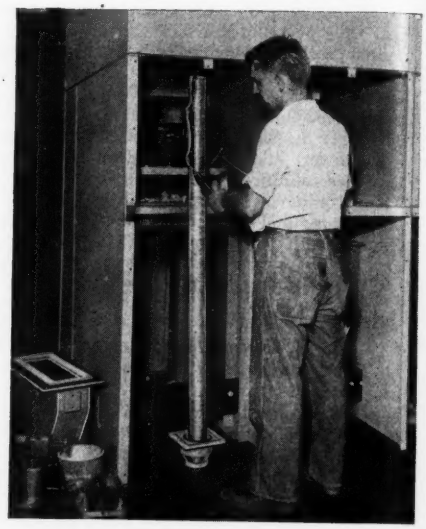


Fig. 4. (Right) Lead sheath is ripped down to the required distance, as calculated. See isometric view

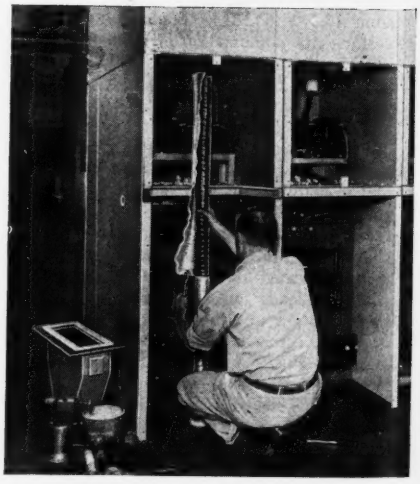


Fig. 5. (Right) Lead sheath is removed and the end of the remaining lead sheath is belled-over as shown in isometric view

Fig. 6. (Right) The interphase insulation is removed, the splicer being careful not to harm the insulation of the single conductors

IN METAL-CLAD SWITCHGEAR

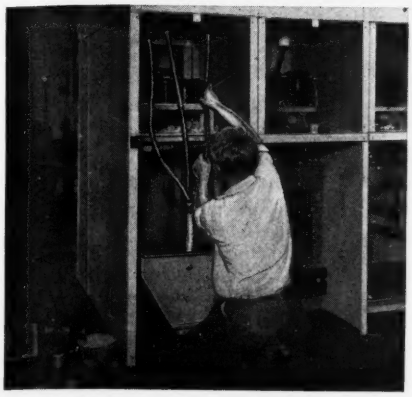


Fig. 7. (Left) The body of pothead is placed over cable and each conductor is fanned-out for maximum spacing of cables. Avoid sharp bends and make sure that each conductor, especially at the crotch end, is not damaged

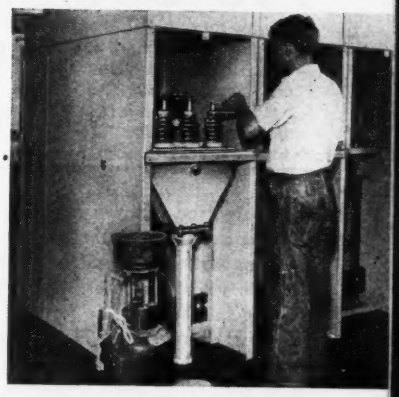


Fig. 11. (Right) Terminal studs being fastened to the insulators by using one wrench to hold the terminal stud in place while another wrench tightens the clamping contact unit

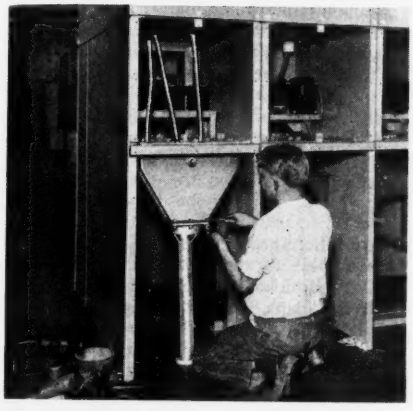


Fig. 8. (Left) Bolting the pothead body and wiping sleeve in place. Conductors are cut to right length. Insulation is removed from the end of each conductor and the ends of the bare conductors are tinned

Fig. 12. (Right) Pouring molten lead onto pads and interconnecting the lead-covered cable and wiping sleeve into one plumber's joint

Fig. 9. (Left) The clamp-type terminal studs are connected to the ends of each conductor

Fig. 13. (Right) The splicer removes filling plug on side of pothead body and inserts standpipe with funnel which must extend above top of terminal studs. Vent plugs at the top of each terminal stud are removed. Then compound, at pouring temperature, is poured in until it flows out of the vent holes in tops of terminal studs. The body of pothead must be kept warm to prevent voids within pothead

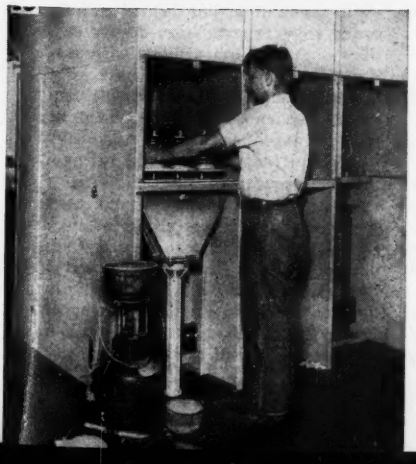


Fig. 10. (Left) Assembling insulators and their supports over the terminal studs. Then the complete outfit is bolted in place

Fig. 14. (Right) Final operation: When compound is cool, the standpipe is removed and the plugs are inserted in pothead and terminal studs. Then the copper connections are fastened from the switch gear to the potheads

I've Been Workin' on the Railroad

By HILDE RUTH MARLIN

It is not often that we can present an article by a woman, dealing with the practical aspects of power plant operation but here is one that all power plant operators will find interesting. Miss Marlin, the author of this article, has been temporarily attached to the staff of Power Plant Engineering on a part time basis while she attends the University of Chicago, but several years ago she worked in the laboratory of the Alton Railroad at Bloomington, Ill., and while there, spent considerable time around the railroad shops and in particular, the power plant. We persuaded her to write this account of some of her experiences on that job in her own words. At present, Miss Marlin is majoring in chemistry at the University of Chicago, in preparation for a career in the field of industrial chemistry, a field with challenging future possibilities

Miss Marlin

IF ANY ONE FIELD was definitely masculine territory it was the one involving the technical aspects of water conditioning and power boilers, which women were supposed to regard with fear and trembling. But the war has changed even that. On December 26, 1941, at the age of seventeen I started to work in the laboratory of the Alton Railroad shops at Bloomington, Ill. The war had already made it impossible to get a properly qualified man for the job, so I stepped in, just out of high school, and with no more than high school chemistry, to fill a job always held by a man with a college degree. My only qualifications were the determination to work hard and an insatiable curiosity.

Fig. 1. We lowered ourselves down through the steam dome, feet first

Water conditioning for the stationary and locomotive boilers on the railroad was the chief concern of the laboratory. I was suddenly swamped with strange terms like carbonate and noncarbonate hardness, ppm, dissolved solids, equivalent $CaCO_3$, ASME, caustic-embrittlement ratio, carryover, etc., etc., that slowly began to make sense after a while. But contrary to my conception of a laboratory technician's work, I found that here, the technical part of water treatment was only a small fraction of their responsibility. In this laboratory practical results and not pushing a pencil were the final criterion of success, and the laboratory staff accepted the responsibility for clean boilers to the extent of inspecting them personally. A sewing machine had been the extent of my contact with machinery, and so I still remember with a thrill of pride the day I first learned the difference between a pipe wrench and a monkey wrench.

Maybe because I knew that I knew nothing, and asked questions unashamedly, that the men around the laboratory took an amused pleasure in teaching me. Probably nothing can ever fascinate me more than the first few lessons in brazing and welding, or acquiring the ability to drive a nail in four hammer blows.

From the first day that I began to look around the shops, the powerhouse seemed easily the most intriguing place, because my boss had strictly forbidden me to go in at all. I thought at the time that it was a nice concern for my safety, but later he said he was just as much interested in protecting the powerhouse men. But because they were in need of some help on tests and I was exceedingly persistent, he finally gave me permission to go into the plant. From then on nobody could tear me away, although I must admit I took to whistling if I approached around shift change time.

One of the firemen enjoyed teasing me because I accepted everything a power plant man said as the gospel truth. When some boiler erection work was in progress and I was already awed by the almost effortless strength of the steelworkers, he tried to tell me how tough they were. I really believed him until he got to the part about eating nails for breakfast. However, after I had made friends with them I found "the heart of gold". And the longer I worked with men in dangerous "he-man" fields the more strongly I became convinced that you always find it.

Just before I had started to work, the power plant had finally come to the attention of the management because it was, like so many industrial plants at the end of the depression, in a condition politely known as deplorable. In 1930 there had been eight boilers (two B&W Stirling Type A, rated 15,500 lb per hr, and six Type S rated 12,500 lb per hr) already on the shady side of 30 yr old. Four of the Type S boilers were dismantled because of general deterioration, and the depression made it impossible to replace them. So when the rush of business preceding the war hit the plant, it was limping along on four boilers, two of which were already in worse shape than the four that had been torn down. In fact when they were finally dismantled after nearly a year's continuous service without a stop for washout or inspection, it was found that they had been definitely dangerous. The steel framework had been completely corroded away and the drums were resting almost entirely on the brickwork, which had swayed out and settled. No one could have said how close they were to failing completely or why they didn't.

Hurricane in a Breeching

When a new B&W Type FF boiler, 37,500 lb per hr, was put up to take their place, it was necessary to cut off about 40 ft of breeching which had led to the dismantled boilers in order not to have a dead end which would reduce draft efficiency. So, on a Sunday the boilers were banked and the boilermaker gang did the job. I had threatened everything but armed revolt in order to get permission to watch, so they let me climb around wherever I wanted. The catwalk in back of the upper drums had been supplemented by a wooden scaffolding about flush with the top of the boilers, and I poked into everything outside and then went into the breeching itself.

I was completely amazed at the huge size of the breeching when you actually get inside, and even though the boilers were banked, the draft felt like a hurricane. It was like climbing a mountain against a sand blasting machine to walk against that draft and against the bite of the fly ash up to the

Fig. 2. There was room enough to stand up and walk around in the firebox

boiler entrance. And from such a vantage point, the boiler really looks like the immensely powerful, half alive thing that it is. Looking down on the fire, there was no actual light visible but just a glow and the tremendous rush of flue gas, reminding me of pictures of the boiling sulfur and brimstone of Hades.

Some of the laborers were afraid to work in the breeching, and you can imagine the ribbing they got from the rest of the gang when a five foot four, 110 lb girl appeared in it.

Indicating the Air Compressors

About this time air production became critical and every attempt was made to coax more compressed air from two ancient cross-compound steam-driven air compressors in the engine room. We decided to indicate both the steam and air ends in order to get a better idea of what they were doing. I helped to set up the indicators, acquiring a few blisters and a profound respect for the temperament of machines. We got a good set of cards which I planimetered and calculated to the surprise of my boss and to my own satisfaction. I began to feel like an old hand around the plant.

One of the high spots of my railroad career was the interior inspection of a locomotive boiler for extension of time on flues. A federal inspection is required if a set of flues is to run more than four years without removal for shell inspection, and the railroad, of course, has its own inspector to determine whether such an extension should be requested. The 5298 (a Pacific type passenger locomotive) was due for an inspection in Bloomington roundhouse.

So one fine morning I donned my coveralls and cap, borrowed a pair of gloves that were ten sizes too big, stuck a flashlight and a hammer in my hip pocket—and the boiler inspector, my boss and I went clear through the roundhouse before any of the men recognized me as a girl. Practically all I heard when we arrived at the engine were repetitions, with and without variation, of "Don't drop your flashlight in the boiler, and don't slip and break your neck."

It's strange how very high a locomotive is when you get on top of one, but the desire to see what made it tick kept me so interested, that fear of the height didn't enter my mind. The main point to climbing around on top of locomotive boiler in an enginehouse is to look up before you stand up in order to avoil bumping your head on overhead piping or on the enginehouse roof.

We Inspect a Locomotive Boiler

The boiler had been cooling for only a few hours and was still hot enough to blister when we lowered ourselves down through the steam dome, feet first. This opening is often too small to permit large men to be boiler inspectors but I had no trouble inching my way down onto the flues. Once inside there is about 18 in. between the flues and shell top in which you must crawl to both ends and turn around. This feat gave me a great respect for the contortionist abilities of a boiler inspector.

I had never realized how much skill boiler inspection takes until we started to hunt for the dangerous and almost invisible cracks that might be present in the myriad flues, braces and staybolts. They must be detected by visual inspection under the coating of boiler sludge and would never be found by a novice. To the inspector's trained ear the gage of a flue can be told very accurately by the sound of a hammer blow on it, but I was surprised to find that the tightness of the braces can best be told by striking them with the flat of the hand since a hammer blow will not vibrate the whole rod so that rattling can be detected.

I had been told not to let the fear of closed places (claustrophobia) affect me. However, although this does scare some people, I noticed mostly the extreme heat and humidity. While we were inside the boiler I heard someone outside say "Are you ready to put the dome cover back on?" It didn't register at the moment but I later learned that it was a stock practical joke to initiate new boiler inspectors and I can well understand how terrifying such a thing might be.

Being part of the laboratory staff I was plenty proud of the clean flues we found, maybe a layer of 1/16-in. scale at the front end, but there was bare iron showing at the back end. When it came time to crawl out I realized that it was far harder than getting in. Anyone who has inched his way around the dry pipe in a sort of S-curve wriggle, pulling solely with his arms, will appreciate my frame of mind as I poked back out of the steam dome only to have a flash blind me because my boss wanted to take pictures. I was mad mainly because I knew how I probably looked, wringing with sweat and dusted with white boiler sludge, and, as you can see from the pictures, I wasn't wrong.

Next, it was necessary to make the firebox inspection. Some inspectors enter a locomotive firebox head first, some feet first; it is a matter of personal preference. In the firebox, unlike the boiler, there was room enough to stand up and walk around. The boiler inspector determined the soundness of the seemingly endless number of staybolts in the sheets by tapping them with his hammer to see if they ring true. Very few of the bolts in this firebox had been undercut by fly ash erosion, and the back flue sheet was also in pretty good shape. No woman was ever more painstaking with fine embroidery than the boiler inspector is in his work, because on him lies the responsibility for the safety of both passengers and crew.

A locomotive is no longer the bewildering thing it once was to me, but it is vastly more interesting because I have some idea of "what makes it tick". As we walked back to the lab I could not resist pointing out that I still had my flashlight and that my neck was not broken.

There is one thing that always bothered me when I worked on the railroad and that was the fact that none of my friends could understand the jokes that I thought were exceedingly funny. I remember one that is a corker for power plant men. This is really true, by the way, but it happened about 20 yr ago. It seems that there was an old night shift engineer who was so proud of his boilers that he talked to them as if they were alive. He would walk up and down in front of the stokers

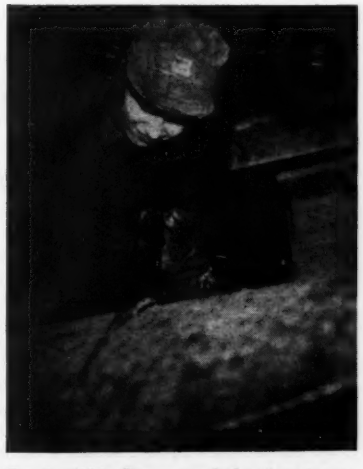


Fig. 3. Wriggling around the dry pipe required contortionist abilities

banging at them with a stick, getting appropriately angry when they didn't raise steam fast enough and praising them when they did. Well, after one stormy winter night when there had been a heavy load with bad water, the day engineer came on just in time to see the night shift man look up at the water in the gage glass and say, "Well, good morning, good morning, haven't seen you all night!"

Cleaning the Boilers

The cleaning of boilers and water lines by chemical treatment is regarded as quite a modern innovation but the Alton laboratory did it some 20 yr ago. I helped with the cleaning of the powerhouse feedwater lines by the use of inhibited muriatic acid one Sunday, managing to get the acid fumes up my nose and being generally awkward. We used about six carboys of commercial grade muriatic, the acid through the lines again and again until the acid no longer foamed, coming through clear. In order to be sure that the lack of foam was not due to worn out acid we used methyl orange indicator mixed with sodium carbonate in previously calculated proportions, adding the mixture to a pint of acid. The red acid-color of the indicator faded to yellow if the acid was nearly exhausted. I remember thinking that the red acid with its carbon dioxide foam looked exactly like a strawberry soda.

Since the powerhouse was now familiar ground I climbed over everything from the ash pits to the coal bunkers, and once helped to candle the breeching and boiler settings for leaks. But there was one thing which I never quite succeeded in doing, and that was climbing the stack. I announced my intention of doing so in spite of its 160 odd feet, and "When are you going to climb the stack?" became a standard question wherever I went around the shops. However, that was the one thing at which my boss drew the line and I never did get to the top. Something to look forward to, isn't it?

But I guess the thing I liked best about the railroad was not the machinery at all, it was the men. Often when a woman hears that I worked on a railroad, the first thing she will say is "But, my dear, weren't the men rather rough to associate with?" And I can answer very truthfully, "No. Railroaders are the finest gentlemen I ever hope to meet."

Casting Explodes—History of an Unusual Experience

By Paul R. Duffey

RECENTLY one of the cast iron Corliss Valve Gear steam arm control dash-pot plungers, with steel plunger rod (See Fig. 1) on one of our 28-52/36 and 8 horizontal cross compound high pressure pumping engines, built in 1912, developed a loose connection between the threaded lower end of the steel rod and the internal threading in the cast iron ball of the ball and socket joint of cast iron plunger. Repairs were arranged for in our shop.

At the repair shop it was decided to follow previous experience with similar plungers, and carefully build up the worn threads of socket ball, and then retap the threaded hole without removing the ball from the socket. (This could be done in our case by positioning the ball tightly within the socket.) Preparatory to the actual brazing job the ball would be heated by means of oxygen-acetylene torch. Due to this heating there was a resultant explosion of the cast iron (cored) plunger which caused many small shrapnel-like pieces of metal to go in all directions. (See Fig. 2.) In Fig. 2, the piece encircled and marked "X" was blown through a closed shop window, and came to rest 150 ft from the welding table.

THREADS ON END OF DASH POT ROD AND IN THE BALL JOINT WERE BADLY WORN.

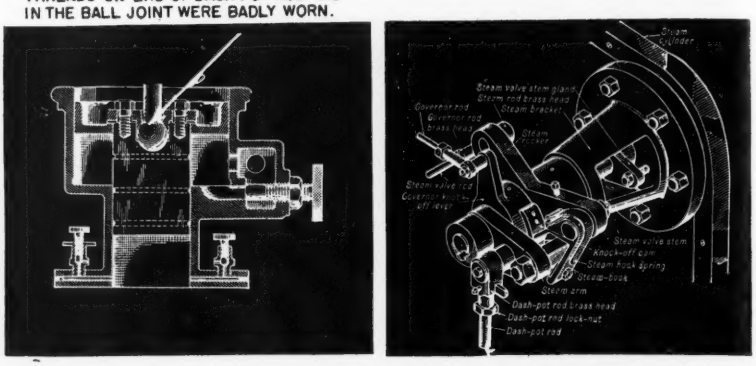


Fig. 1. Details of the Corliss Valve Gear and Dash Pot

Workmen involved in making repairs did not take into consideration the fact that they were dealing with a hollow, thin walled, cored casting into which through a period of years apparently a mixture of oil and water had seeped, partially filling the cored section of main casting. Sufficient heat was applied to the casting to cause the emulsion in casting to vaporize and/or boil to point of generating sufficient pressure to cause the casting to explode.

True enough, the ball could have been removed from its socket for making repairs; however, similar repairs on previous occasions had been successfully undertaken without such an occurrence as described, and it was generally assumed that the casting was solid, and apparently no one questioned in his mind, why the screwed plug had been applied to the bottom section of casting, and a smaller plug, not normally exposed to observation was located in the bottom of ball socket in the casting.

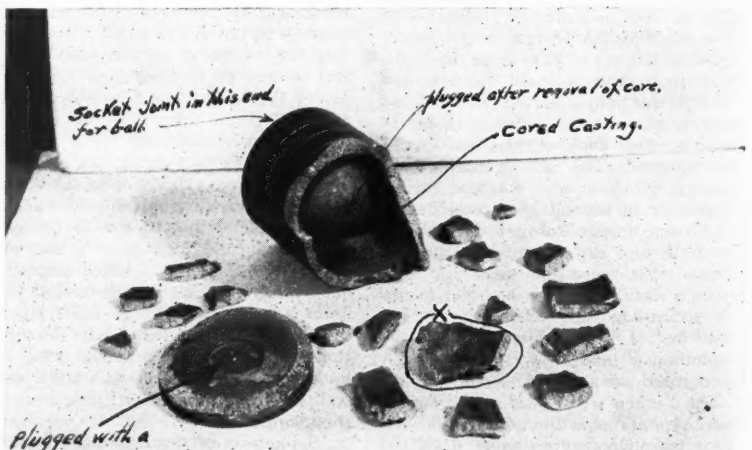

Socket Joint in this end for ball
Plugged after removal of core.
Cored Casting.
X
Plugged with a screwed in plug after removal of core.
FIG. 2.

Fig. 2. Photograph showing the effect of the explosion

How to Fight Different Kinds of Fires

MOST INCIPIENT fires can be put out in a fraction of a minute, if the extinguisher operator knows how to use his equipment to best advantage.

In fighting a fire in ordinary combustibles (wood, paper, textiles, etc.), the extinguisher stream should be aimed at the base of what is burning, and not at the smoke and flames. Application should be continued until the fire is completely out. Then the operator should search the remains for glowing embers and drench thoroughly any that he finds.

Fires in Flammable Liquid

Fires in flammable liquids generally fall into two categories—those in containers of liquids, and those in spills If a foam, vaporizing liquid or loaded stream extinguisher is used, the operator should play the extinguisher stream against the far inside wall of the container just above the burning surface. This will avoid splashing and permit a natural spread of the extinguishant back over the burning surface. Where possible, the operator should walk around the container while directing the stream, so as to get maximum coverage during the discharge period. Where an operator using a foam or loaded stream extinguisher must remain at a considerable distance from a container of burning liquid, the extinguishant, directed at a high angle, may be allowed to fall lightly on the burning surface. In no case, however, should the stream be directed into the burning liquid.

CO_2 Extinguisher

If a carbon dioxide extinguisher is used, best results can be obtained by directing the discharge as close to the burning surface as possible, starting nearest the operator and then progressing forward, moving the discharge horn slowly from side to side. The discharge should be continued even after the flames have been extinguished, to cool the liquid and prevent a possible reflash.

In fighting fires in spills, the operator should put out the flames nearest him first, and then slowly sweep out the fire as he advances along its path.

Fires in Electrical Equipment

Fires in electrical equipment should be fought the same way as those in ordinary combustible materials. If vaporizing liquid or carbon dioxide extinguishers are used, the operator can advance as close to the fire as necessary before the current is turned off—though best practice is always to turn off the current first. If water or water solution extinguishers are used (though they are not recommended for fires in electrical equipment), the equipment must be made electrically dead before application begins; otherwise damaging short-circuits can result and, if the voltage is high, a harmful charge may travel up the hose stream to the operator.

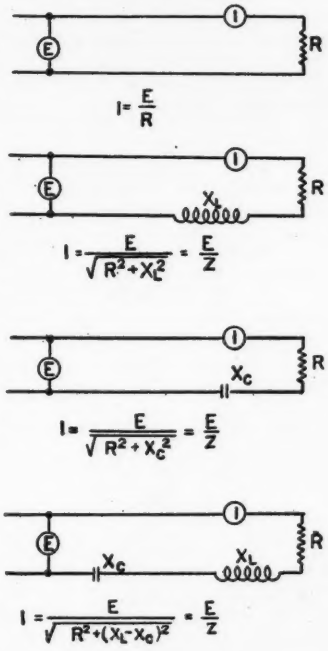
Safety Rules

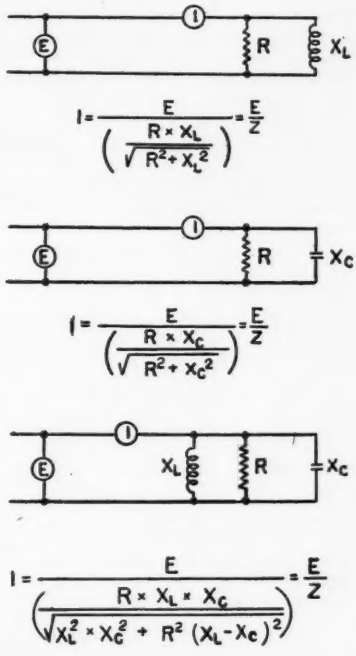
A few general safety rules should be kept in mind. The operator should stand as far from the fire as conditions, and effective use of the extinguishing agent, will allow. In the case of a 2½-gal soda-acid extinguisher, the effective horizontal discharge length is from 30 to 40 ft; in that of a 15-lb carbon dioxide type, about six ft. The operator should maintain his position between the fire and an exit to permit ready escape; and, if the fire is outdoors or in the path of a strong draft, he should stand to windward (his back to the wind). As soon as the fire is out, the area should be thoroughly ventilated.

Formulas For Determining Current in A C Circuits

ON PAGE 126 of the May issue of POWER PLANT ENGINEERING we presented a chart showing a number of diagrams of circuits with various combinations of resistance, capacity and inductance together with the formulas for determining the current in the respective circuits. These formulas and diagrams were abstracted from Vol. 1 of Maintenance Hints published by Westinghouse Electric & Mfg. Co.

Unfortunately everything seems to have gone wrong in the publication of this chart. Not only were certain errors carried over from the Westinghouse publication, but others were made in redrawing the data. Since many readers were kind enough to call these errors to our attention and since there seems to be a great interest in these diagrams and formulas, we are presenting the corrected forms herewith.




E
I
R
X_L
$I = \frac{E}{\left(\frac{R \times X_L}{\sqrt{R^2+X_L^2}}\right)} = \frac{E}{Z}$
X_C
$I = \frac{E}{\left(\frac{R \times X_C}{\sqrt{R^2+X_C^2}}\right)} = \frac{E}{Z}$
$I = \frac{E}{\left(\frac{R \times X_L \times X_C}{\sqrt{X_L^2 \times X_C^2 + R^2 (X_L-X_C)^2}}\right)} = \frac{E}{Z}$

R = Resistance in ohms
X_L = Inductive reactance in ohms = $2\pi fL$
X_C = Condensive reactance in ohms = $\frac{1}{2\pi fC}$

Z = Impedance in ohms
I = Current in amperes
E = Impressed voltage in volts
f = Frequency in cycles per second
L = Inductance in henries
C = Capacity in farads

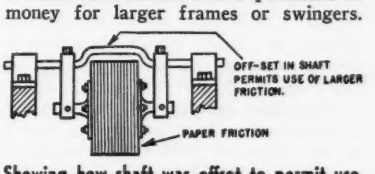
Offset in Frame Permits Larger Friction

By J. R. Kennedy

IN REMODELING an industrial establishment recently it became necessary by reason of some much-needed enlargements to use larger paper frictions than could be accommodated by the frames formerly used in the establishment.

In simple language, a paper friction hanger consists of two swingers or arms suspended from a length of shaft. Both ends rest in oilless bearings. In this case the shaft from which the frictions were suspended was long enough to permit a few alterations.

The job was done successfully as follows: After determining how much extra room was needed by the larger frictions which it was desired to install, the swinger shaft was removed, carried to the plant's shop, heated, and given the necessary amount of offset, as shown in the accompanying sketch exercising care not to allow a bend to interfere with the proper spacing and positioning of the swinger arms. This permitted frictions of the desired size to be put immediately into use without the loss of much time or expenditure of money for larger frames or swingers.



Showing how shaft was offset to permit use of large paper friction

The Case of the Dirty Lanterns

As explained in the analysis of the solutions to Problem 34 on page 100 of the July issue, space was not available in that issue for the presentation for all of the best letters. For this reason the discussion of the problem is continued here. While the solutions given here were not among those winning awards, many contain good suggestions and stimulating ideas

So much for Mr. Roulston's comments. Now we come to C. C. Porter's letter. Mr. Porter is chief chemist at Southland Paper Mills, Inc., at Lufkin, Texas. He says, "Our Hero's question can best be described as *misleading*—the dirty lamp will not throw out more Btu's than the clean one. The method of heat transmission from the flame to the lowly spud will differ however. The theoretical difference lies in the phenomenon known as the Black Body temperature of the dirty lamp.

"The lamp is an ideal example of a radiation study. Lampblack is the best absorber of radiant energy from the flame, clear glass about the poorest. If the lamp were clean and burned with a smokeless flame, the Btu's would be transmitted to heating the air, after which the potatoes would be in turn warmed by the surrounding atmosphere. Gases are very poor absorbers and radiators of radiant energy. A burning gas that contains no solid particles emits very little energy in either luminous or non-luminous waves. If the flame contains particles of carbon, there will be considerable radiant energy emitted in both luminous and non-luminous waves.

"Lampblack is our best absorber and our best radiator. Now to explain why the potato is receptive to the absorption of the radiant energy emitted from the dirty lamp (the clean lamp emitting practically no radiant energy). The property of a body for transmitting radiance is called *diathermancy*. Gases (in this case the air) not near the point of condensation are highly diathermanous. The radiant energy is thus easily transmitted through the atmosphere and thereupon raises the temperature of Mr. Spud.

"A good example of the heating qualities of radiant energy is found in the common cold frame which is used to protect plants from frosts. It consists of a bottomless box with a glass top and resting on the ground. Most of the solar radiance transmitted by the glass is absorbed by the ground and transformed into heat. Though the warmed ground radiates energy, this energy is of such long wavelengths that very little is transmitted by the glass. Consequently the temperature of the enclosure is higher than that of the air outside"

E. B. Moore, Service Engineer of the Northern Illinois Coal Corp., also points out the fact that the problem is not one of quantity of energy but the form in which it is radiated. "We must assume that this is correct" he writes, "since it is doubtful whether the lanterns consume any more fuel whether dirty or clean. If the lantern is dirty, however, little of the energy of the flame is allowed to pass from the lantern as light. Consequently, the temperature of the glass in the lantern is raised; this heat is then transferred to the air surrounding the lantern and then circulated by convection among the potatoes.

"A common and familiar example of this phenomena is the fact that a pane of window glass on a bright winter day with the sun streaming through it is cold to the touch whereas the spot where the sun strikes the floor will be quite warm. This illustrates the fact that in order for heat rays to raise the temperature of an object they must not be allowed to pass directly through that object.

"To get back to Our Hero amongst the potatoes and lanterns: if the lanterns were cleaned, those potatoes which could see the lantern would be raised in temperature but those not subjected to the direct rays would be affected but little and their temperature would be raised only by the convected heat transferred to the air from the metallic top of the lantern. This metal top becomes warm due to the fact that the rays do not pass through the metal. Some of us may have learned this the hard way i.e., a burnt finger.

. "In closing, Our Hero might suggest to Mr. Parker that he could still further increase the efficiency of his method of curing his potatoes of cold feet by converting the lanterns into miniature kerosene stoves. This could be accomplished by substituting a short length of stovepipe of the proper diameter for the globe of the lanterns."

Sam Williams, a frequent contributor to these pages, seems somewhat startled to think that Our Hero seeks to confound the grimy handed engineering clan with the subject of "Black Body Radiation." After briefly discussing the transmission characteristics of clean glass with respect to radiant energy, he proceeds to the details of the dirty lamp. He points out that "a rough black surface is ideal from the standpoint of heat absorption." This type of surface exists on the inside of the glass globe. Due to the roughness of the surface, the light and heat waves are repeatedy reflected into the body of the glass and their energy is absorbed by the glass mass. This results in a higher temperature of the globe.

"Nature, being what she is" continues Mr. Williams, "she has ruled that a body capable of great absorption is also a good radiator. So the blackened globe, while absorbing a great amount of heat from the interior of the lighted lantern, also radiates a large amount of heat to the cool atmosphere. At the same time the higher globe temperature increases convection currents which further aid in the dispersion of heat. It is doubtful, that the lanterns throw more heat because of the dirty globes but if they do it is perhaps because the blocking of light by the blackened globes causes an increased temperature within the lantern, thus promoting efficiency of combustion. At any rate whatever heat is not given off by the globe through radiation is dissipated by the smelly exhaust of the lantern. Despite all this, the spuds are kept at the desired temperature but I still would like to ask, would not a charcoal salamander be cleaner and better?"

H. F. Pokorney of Chicago sent us a solution to the problem that was quite different from many of the others. Quoting from his letter,

"Our Hero is not positive that the dirty lanterns give out more heat then the clean lanterns because Mr. Parker informed him 'these dirty lanterns *seem* to give out more heat—'. Evidently our Hero is not very inquisitive or he would have attempted to determine the actual temperature difference that seemed to exist.

"We could probably tell our Hero anything we wanted to and get away with it. However, he seems rather mystified about the whole thing so we will take him into the laboratory and let him see with his own eyes just what was taking place in Mr. Parker's root cellar.

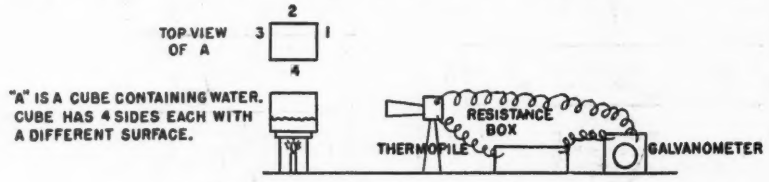


Fig. 6. H. F. Pokorney's experimental setup

Duke Says—
"...We agree with you Joe... corrosion in steam lines is plenty severe*"
Duke Cosner
National Aluminate Corporation
* Joe, a master mechanic in a large industrial plant says—"corrosion shows up very heavily in the steam lines... makes us inspect valves and pipe lines often... in some places valves and pipes won't last a year..."
Source: Survey conducted by a well-known power publication.

...but Nalco can prevent it!

Listen Joe, you don't have to have corrosion in your plant, because the Nalco System prevents corrosion, makes valves and pipes last longer, and what's more the Nalco System of Feedwater Treatment stops scale and carryover with its subsequent heat losses, damage and shutdowns.

Nalco engineers and chemists, with the world's finest and most modern water treatment laboratories at their disposal, approach the subject of water treatment from the standpoint of an exact science . . . There's no guesswork with Nalco.

Take our advice Joe, and call for a Nalco survey today . . . let us show you what Nalco can do to overcome corrosion in *your* plant. There's no obligation.

Nalco

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place **Chicago, Illinois**

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

. . . The Complete Water Treating Service

"First we will set up apparatus as shown in Fig. 6.

"With the cube removed we adjust the galvanometer so it reads zero. Then we replace the cube and heat the water so it boils gently. Now we face the lampblackened surface to the thermopile and take a reading. Then we do the same thing with the other three surfaces. We tabulate our results thus:

Surface	Galvanometer deflections	Radiating power
Lampblack	442	100
Polished	212	212/442 x 100 = 47.9
Dull copper	348	348/442 x 100 = 78.7
Papered	395	395/442 x 100 = 89.2

"Our Hero can now go back to Mr. Parker and explain to him that the radiating power of a given surface depends upon the nature of the surface and also upon the temperature, and is generally expressed in terms of a surface coated with lampblack which is taken as 100. As Mr. Parker has lampblack inside his lanterns he is getting about maximum radiation possible and as the above table indicates very much more than if he used a polished glass surface entirely clean."

Conclusion

Space does not permit us to present more of the many excellent letters received on this problem but in closing mention should be made of several others. There was the letter of Dr. Tom H. Jones of Lancaster, Pa. for example. "Frankly," he writes, "it might have been better to have stayed in bed rather than to have gotten involved with Our Hero in dodging the psychopathic wards."

Apparently he did not pursue the wise course because his letter analyzes the problem in a manner similar to those already given and he bases his analysis on the Stefan Boltzman equations.

Others deserving mention were, R. G. Vanderweitz of Woodbury, Conn., Raymond Sundquist of Westwood, Colo., Stephen S. Allwell, Baltimore, Md., and Homer H. Crider, Yosemite National Park, Calif.

LETTERS AND COMMENTS

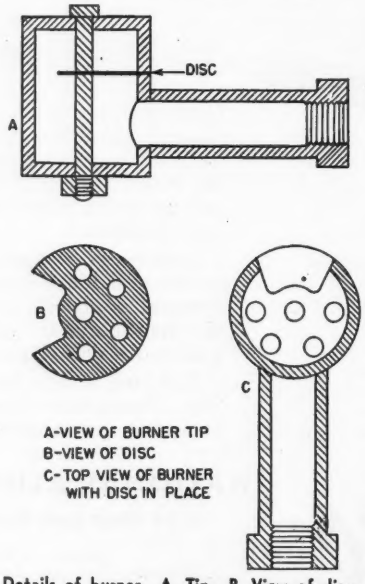
On Holding a Chief's License

REFERRING to Ivan E. Golden's letter on page 110 of the May issue, I feel his comments are very good. I held a first class license 17 yr before I even tried to get a chief's license; I preferred to get some experience along with my "book learning." Today I have both, and room for more. In my library at home I have several dollars invested in what I consider the best in engineering books. I treasure them highly and often refer to them just to keep the memory in tune if for no other reason. Yes, sir, it's up to the individual himself. I may get a whack at a chief's job some day and I'd hate to go boom! Now about the article by Mr. Arthur H. Parker. Well, *maybe*. Take my own case. The chief has told me more than once and has also told others that when he went home and left me in charge he need have no worries. That in itself is enough for me. I am in a plant owned by a large outfit in another city. They operate five plants of this same type and of course have a traveling engineer. He may or may not be an *engineer* but he sure has some awful screwy ideas. His final orders must be carried out and he definitely is not open to suggestions from anybody. I'd never even consider being a chief in one of these plants when he can have anything to say about my plant. When I get a chief's job I'll be darned if I'll let anyone else run my plant and then be the goat when things go haywire.

ROBERT BAKER

Adapting Oil Burner to Both Summer and Winter Use

ONCE UPON A TIME as all stories begin, I was an engineer in a hospital having among other duties an HRT Boiler to take care of, fired with a steam atomizing oil burner, carrying a heating load, which was more or less variable as well as seasonal. In the winter we had a capacity load, and in the summer, especially during the warmer months, hardly any load at all during part of the day. The burner tip being of cast brass with a slot cut in the front side of it with a hack saw provided a problem since an opening suitable in size and shape for winter use was much too large for summer use and, vice versa. It was imperative to keep steam up at all times, so the assistant chief and I took the burner tip, sawed the top off where the slot was, put the parts in the lathe and finished them off smoothly. Then we drilled a 3/8 in. hole down through the center, made a disc out of sheet iron as shown at B, which we put between the parts and bolted the whole together as shown in A.



Details of burner. A, Tip. B, View of disc. C, Top view of burner with disc in place

By making up discs of different thickness, 18 to 21 gage proved most effective and with openings of different widths and angles, we were able to adjust the burner tip to suit any load as might occur. Another convenience we found was that by turning the disc we could "Wing" the fire wherever we chose. We were burning 400 viscosity fuel oil at a temperature of 160 F and maintained a boiler and furnace efficiency of 86 to 89 per cent with a draft under the stock damper of 0.25 to 0.4 in.

Seattle, Wash. N. W. DUELL

A High Voltage d-c Generator

THE SCHEME W. S. outlines in the June issue, for a high voltage d-c generator with no commutator brings to mind the same general idea I had some time ago, for a high voltage generator to supply direct current to a radio transmitter.

After studying the idea for some time, I decided that it could not be done.

First let us consider a conventional direct current generator. As each armature coil, starting from a point of no magnetic flux, passes to the point of maximum flux, on to zero, to maximum flux of opposite polarity, and to zero again, one full cycle of alternating voltage is induced in the coil. When this coil is passing through a point of no magnetic flux no voltage is generated, and as it comes into the magnetic field the voltage will increase in proportion to the rate of increase of the magnetic flux and reach maximum at the point where the change of magnetic flux is at its maximum.

As the coil moves into a position of decreasing flux the voltage will decrease until it reaches zero and start increasing in the opposite direction while passing through the area of opposite magnetic flux.

Now these coils are connected to the commutator, and brushes so placed around the commutator that coils connect to brushes of opposite polarity while the voltage induced in the coil is at its maximum.

When the coil has moved 180 electrical deg, the ends of the coil connect to opposite brushes, therefore, the voltage at the brushes is still of the same polarity although it is opposite as far as the

LUNKENHEIMER VALVES

Spell "Low Maintenance"

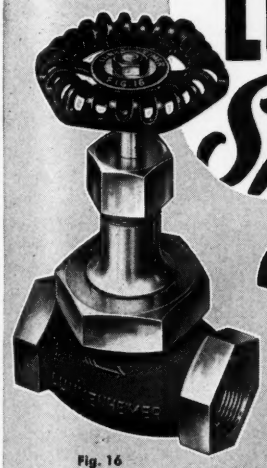


Fig. 16
"Renewo" Globe

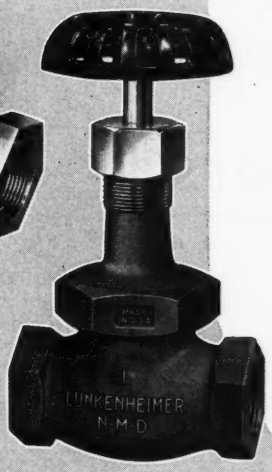


Fig. 123
"N-M-D" Globe
(Non-Metallic Disc)

Long service life and low maintenance have ever been the goal of Lunkenheimer design. Ask users why they prefer Lunkenheimer Valves and their answer is universal—"they're built to last and give the least amount of trouble."

These staying qualities are particularly important when production is running at previously unheard-of tempos — when "time out" is figured in loss of vitally needed equipment, rather than mere dollars. Lunkenheimer Valves are helping many a maintenance crew do a better job easier.

Illustrated are just a few of the many types of valves in the Lunkenheimer line—bronze, iron, steel and corrosion-resistant alloys—for all prevailing pressures and temperatures.

Your Lunkenheimer distributor is always ready to help you with your maintenance, repair and operating problems. His facilities and experience are at your call.

Fig. 2125
Bronze Gate

Fig. 1640
"King-clip" Gate

Fig. 1430
Iron Body Gate

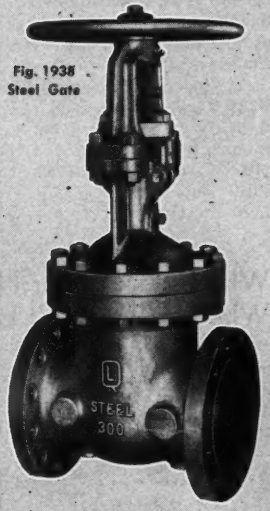


Fig. 1938
Steel Gate

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO. U. S. A.
NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 7
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

coil is concerned.

The voltage induced in the coil, with a stationary field and moving coil, or a stationary coil and moving field, will be the same, provided the magnetic flux and rate of change of flux at the coil is the same in both cases.

Now if we build a generator as outlined by W. S. which by the way would be similar to a single phase, rotating field alternator, and excite the field with alternating current, and so regulate the speed that one pole would pass from one side of a coil to the opposite side during 180 electrical deg or one-half of a cycle of the field flux in order to have the magnetic flux always in the same direction at the coil, then there would be no change in the magnetic flux, as far as the coil is concerned, and no voltage would be induced in the coil.

Dalton, Mass. FRED E. GOULD

Questions And Answers

Question No. 267

Will Increased Clearance Cure Valve Slap?

IN OUR PLANT we have a Brownell 12 by 14-in. twin steam engine, 1913 model, that has always had a bad valve slap on the head end. Indicator cards show very high compression. The engine is variable speed, from about 75 to 400 rpm. Piston clearance is 3/8-in. now.

At slow speeds, we can eliminate this valve slap by opening the ½-in. cylinder drain cocks. Because of this, we are wondering if we could put a plate or shim under the cylinder head to move it out and increase the clearance and thus stop the valve slap. How could we figure out how thick this cylinder head shim would have to be? What effect would increasing this clearance have on the efficiency of the engine?

We have checked the piston clearance at both ends, which seems all right. We have changed the eccentric adjustments at all angles and tried everything we can think of but to no avail. We sent the cylinder blocks and valves into the shop recently, had them machined and they are in fine shape, but we can't put enough spring pressure on the pressure plate to do any good in stopping the valve slap.

Lebanon, Oregon R. H.

Question No. 268

Why Does Heater Heat When Light Won't Light?

IF YOU HAVE a heating element connected across a 110-v circuit as shown in the sketch, all of the element heats up. If you connect a test lamp from area A on the heating element to ground, the lamp will light. But when you connect the test lamp from area B to ground, the light does not light; showing that there isn't any current in that area. What I want to know is: Why does that area also heat up?

Newport, Arkansas J. D. T.

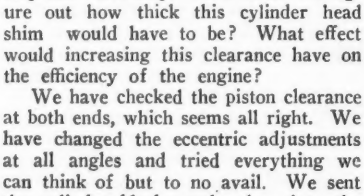


Diagram of J. D. T.'s heater connections. If grounded test lamp lights when connected at A but not at B, why does entire heater element heat up?

Answer No. 253

Who Knows About Flash Type Boilers?

THE BRETHREN certainly did rally 'round to show J.S.L. where he can get some information on a flash type or other small steam generating unit that will make 1000 to 3000 lb of steam an hr at around 600 psi, as he requested in the March issue.

J.S.L. said he was interested in getting some sort of small boiler unit to furnish steam in connection with a certain apparatus his company is developing. He says he will tell us what it is as soon as it is a little farther along but so far we have received no more information as to how the boiler is to be used.

However, the first reader to comment on the subject certainly covered it from many angles. Here's his letter:

Ulrich Tells About Old and New Types

BOTH THE old White steamer and the much later model Doble steam cars had seamless steel coil type flash boilers which had operating pressures of about 800 to 1000 psi, generating highly superheated steam in about 30 sec from cold.

However, the old Stanley steam car stuck to the more conservative type vertical flue boiler, which contained over 550 ½-in. copper flues or tubes; and in the last cars made, steel flues were used, welded to bottom tube sheet and rolled at top sheet. These boilers operated at 500 to 600 psi and would raise steam in about 5 to 10 min from cold. The Stanley boiler shell was wound with several layers of piano wire which enabled it to stand the high pressure with safety.

Concerning the Ward boiler used in U.S. Navy steam launches, this was not a flash boiler but a very compact, vertical, water-tube coal-fired boiler operating at about 250 psi with no superheat. I believe the Charles Ward Engineering Works who made these boilers in Charleston, W. Va., are still in business if you desire further information on them.

In modern flash type boilers, the Vapor Car Heating Co. of Chicago, Ill., makes a full automatic oil-fired boiler of the coil flash type operating at moderate pressure but they could probably make a high pressure type also on special order. And there is the Besler boiler for pressures up to 2500 psi.

If the reader only wants 600 psi with little or no superheat with simplicity and reliability and minimum expense, I suggest he stay with the ordinary water tube boiler built to operate at 600 psi such as the single-drum Babcock & Wilcox marine boiler.

The many complicated automatic controls gave plenty of grief on the old steam cars and was the reason the steam cars became unpopular, although the makers of these cars did wonders with what they had to contend with, and they deserve a lot of credit for generating steam at pressures which scared the ordinary person but which today are only rated as moderate pressures.

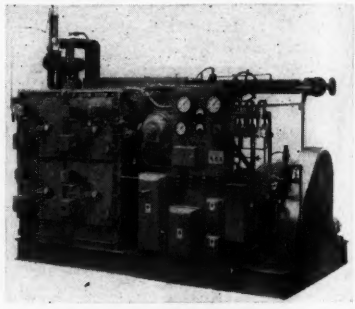


Fig. 1. View of a complete Besler boiler, showing boiler sections at left, auxiliaries at right. These units can produce from 2500 lb of steam an hr up, at pressures up to 2500 psi, 1000 F

Also J.S.L. could advertise or go to the auto wrecking yards and he may find one of the latest steel boilers made by the Stanley people in 1915 when they quit business. These boilers were rated at 20 hp and will make plenty of steam plenty fast at 600 psi with a forced draft oil furnace under them.

Los Angeles, Calif. HENRY A. ULRICH
Operating Engineer
Los Angeles Brewing Co.

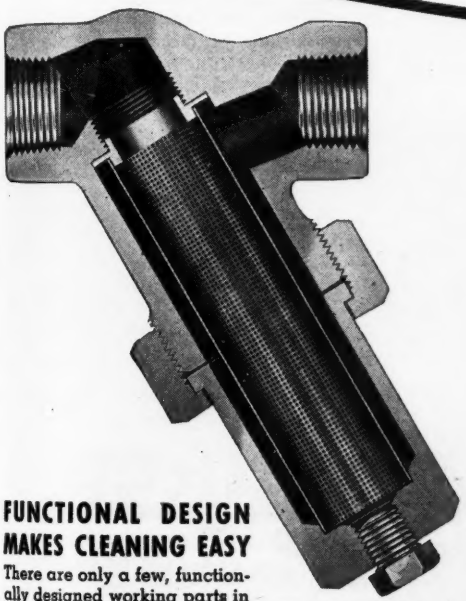
It would seem that the editor stuck his neck out quite a ways in referring to the old Ward steam launch boiler as a flash boiler. But that's what he heard it called 25 yr ago and he wrote it without remembering that the drumless or continuous tube boiler, in which water enters one end of a tube and comes out the other end as steam, was

WHY MR. TATE IS WORKING LATE

It's neither a new or very difficult problem that's keeping Mr. Tate around after hours. Just a little matter of scale in a pressure regulator.

But it could have been avoided easily. Simple, inexpensive, yet highly effective, an Edward forged steel strainer would have done the trick.

It's economical preventive maintenance to protect the delicately adjusted working parts of your traps, pumps, pressure regulators, air motors and valves with Edward strainers. In plants all over the country Edward strainers are preventing unnecessary shut-downs that cost money and keep operating and maintenance personnel on overtime hours.



FUNCTIONAL DESIGN MAKES CLEANING EASY

There are only a few, functionally designed working parts in Edward strainers. Extremely easy to clean, they may be blown out simply by removing the drain plug, or they may be disassembled quickly with ordinary tools to remove and clean the Monel strainer screen. For steam, oil or vapor service up to 600 lb at 850 F or hydraulic service up to 1440 lb at 100 F. Screwed or socket welding ends, sizes ¼ in. to 2 in.

AVOID UNNECESSARY SHUT-DOWNS—Protect traps, pumps, regulators, air motors, meters, and valves with EDWARD STRAINERS.

FOR HORIZONTAL OR VERTICAL LINES

Strong, simple, versatile Edward forged steel strainers may be installed in either horizontal or vertical lines with equal effectiveness.

1. MONEL SCREEN

Rustproof Monel metal perforated screen, fit for severe abrasive service. Careful fitting prevents leakage of foreign matter around or under screen.

2. FORGED STEEL BODY

Streamlined internal body contours cut pressure drop to its minimum and promote free flow.

3. BONNET ASSEMBLY

Steel union ring and bonnet hold screen firmly in place. Drain plug easily removed for cleaning out foreign matter.

THE EDWARD VALVE & MFG. CO., INC. • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES
CAST AND FORGED

not very well known at that time, so there was doubtless a confusion of terminology. Nowadays we don't consider a boiler to be a flash boiler if it carries a water level, said Mr. Ulrich in a subsequent letter, and the Ward boiler certainly did. We have written the Ward company about this.

Mr. Ulrich says that he, like the editor, served in the U.S. Navy "black gang" in the coal-burning days. What memories that steam launch boiler brings back! It was in connection with one of them, hand-fired with coal and installed in a 40-ft steam cutter, that the editor came within an electron diameter of being court-martialled during the warm-up war in 1917. One day when he was engineman of one of those cutters, his fireman poked a slice bar clean through the nipple on the bottom of one of the boiler drop tubes. The resulting commotion in the boiler, however, was a gentle spring zephyr

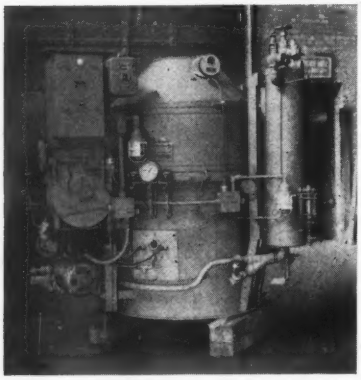


Fig. 2. View of a complete Vapor-Clarkson steam generator, as frequently installed on Diesel trains for car heating

compared with the commotion made by the Commanding Officer after the hapless vessel had been ignominiously towed (about 15 miles) into port—and by a "stink-pot"! The C.O. didn't repeat himself for 15 minutes. It was most distressing!

Returning now to J.S.L.'s problem, R. A. Robbel, Chicago, says: "Let J.S.L. get a 40-hp White steamer auto. This will give him 1000 psi at 300 C (or 572 F) easy. He can replace the engine with a motor to run the pump and his plant is complete. The White steamers were built in two sizes, 20 and 40 hp, by the White Co. of Cleveland, Ohio, now building the White Trucks."

D. E. Woodbridge, Brooklyn, N. Y., states that during the past 20 years he has built a number of flash generators for service such as J.S.L. requires and suggests that the latter get in touch with him.

Here is an interesting letter from P. D. Parker, manufacturer of amusement devices saying he has a Stanley steam car boiler available. The letter is reproduced with his permission, to show his letterhead and make some of you homesick for the old-time county fairs and amusement parks. Mr. Parker also says he has the smallest steam locomotive ever constructed to haul passengers cars and will send us a photo of it.

Finally, here are details of some of the small high-pressure units referred to in several of the above replies.

Figure 1 shows a Besler sectional steam boiler as made by the Besler Corp. of Emeryville, Calif. This is a recent model of the same type of boiler that attracted so much attention in 1933 when is was installed in the first airplane to operate successfully under steam power. It is also being used in railway work, driving the "Besler train." It has been used by many manufacturers to supply steam for testing and for a considerable variety of power applications.

The Besler boiler is of the sectional type, is built for any steam pressure up to 2500 psi and for steam temperatures up to 1000 F, although the standard boilers are for 1500 psi 900 F. Capacities are from 1500 lb of steam an hr up; the upper limit is not specified in the data we have.

The boiler is sectionalized as shown at the left of Fig. 1. Each section consists of a pancake steam generating coil and a helical coil constituting the water wall of the firebox. There are no drums or headers and forced circulation of the once-through type is employed. Each section is fired by oil or gas and a standard section is designed to produce 2500 lb of steam an hr. Separately fired superheaters are used. There are just two designs of boiler section—saturated and superheated—any number and combination of which can be operated together.

The unit is designed to attain full operating temperature and pressure from cold start in two minutes. It is equipped with complete automatic controls and protective devices, built-in soot blowers, starts and stops by push-button control and can be adapted to odd-shaped spaces.

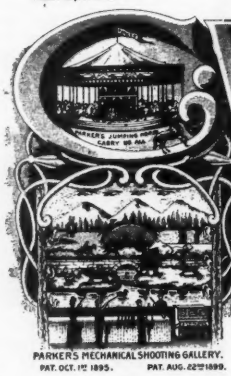
To fit J.S.L.'s requirements, there is a Model 15 Besler boiler, not shown here, that will fire up from stone cold to 2000 psi, 900 F and produce 1500 lb of steam an hr, burning stove oil or gas, all under automatic control. This is called a "test" boiler and is used by packing and valve manufacturers for testing their products.

The steam generating unit of the Vapor Car Heating Co., Inc., Chicago, Ill., known as the Vapor-Clarkson packaged steam generator, is shown in Fig. 2. Although these units are now built for a maximum steam pressure of only 300 psi, there seems to be no reason why they could not be built for higher pressures. The Vapor-Clarkson unit is extensively used on Diesel trains to supply steam for car heating, on board small ships and in commercial applications. There are also portable models.

The Vapor-Clarkson unit is built for capacities of 500, 1000, 1500, 2000, 2500 and 3000 lb of steam an hr. It is fired with Diesel fuel oil on locomotives, while No. 3 domestic oil or better can be used on stationary installations.

These boilers also are of the once-through, forced circulation type. The combustion chamber is surrounded by a coil assembly of three sets of water tubing, connected to form a single tube several hundred feet long, the coils staggered to give proper flow of combustion products. Soot blowers are installed in the coil assemblies. Water is pumped through the coils, a 5 per cent excess of water being provided to aid in maintaining an even temperature and to flush out scale-forming material. This excess water and sludge are separated from the steam in a special separator and the excess also preheats the entering boiler water in a heat exchanger.

LENE, KANS. E.O. APR 3 - 1944 M.O. LEAVENWORTH, KANS.



P. D. PARKER

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ESTABLISHED 1892 AMUSEMENT DEVICES

MERRY-GO-ROUND, PARKER'S MECHANICAL SHOOTING GALLERY, PARKER'S JUMPING HORSE, CARRY-US-ALL, MILITARY BAND ORGANS, CYLINDER PIANOS, CARVED WAGON SHOW FRONTS, ALL KINDS MECHANICAL AND ELECTRICAL SHOWS, CIRCUS, FLAT AND PRIVATE CARS.

MAIN OFFICE AND FACTORY: LEAVENWORTH, KANS.

LEAVENWORTH, KANS. March, 30th, 1944

Power Plant Engineering Magazine,
43 West Jackson Blvd.,
Chicago, (4) Ill.

Gentlemen;

In your issue of March the 4th., question No. 253 regarding "flash type boilers" I am pleased to inform you that I have such a boiler taken from an old Stanley Steam Car, if your party is interested you may have them get in touch with me regarding the matter.

Yours very truly,

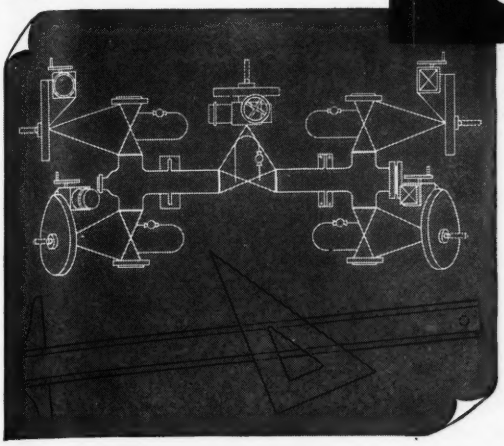
P. D. Parker Pre'st

PDP GPA

Reproduction of Parker's letter. Look at the carry-us-all and the shooting gallery!

Shop-Fabricated Assemblies . . A Complete Service from CRANE

1. ON THE DRAWING BOARD — *No matter how complex your piping assembly design may be, all parts—valves, fittings, and pipe—are supplied by Crane. One source of supply—one order covers everything.*



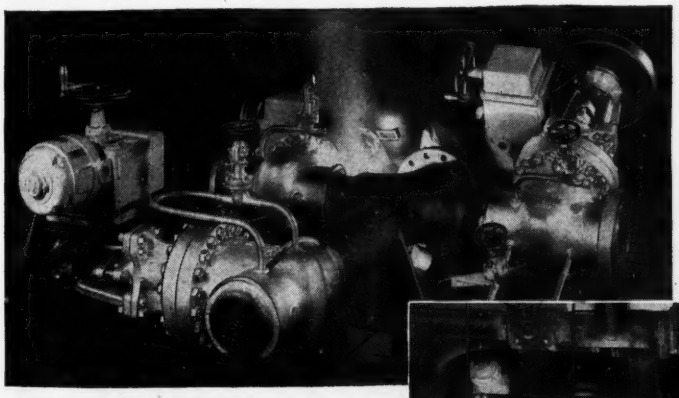
SHOP-FABRICATION typifies Crane complete service in the highest degree. Your blueprint in Crane Pipe Shops means delivery to your installation of a unit meeting every intent of design. For at Crane, no job is too small—none too large or complex—and absolute adherence to specifications is a matter of pride.

As the world's leading supplier of valves, fittings, and fabricated piping, Crane Co. produces all types of header assemblies of valves and fittings. Completely shop-welded, stress-relieved and tested, and conforming fully to code requirements, such Crane-built units—whether for power or processing systems, high or low pressure—stand out as the finest combinations of materials and workmanship.

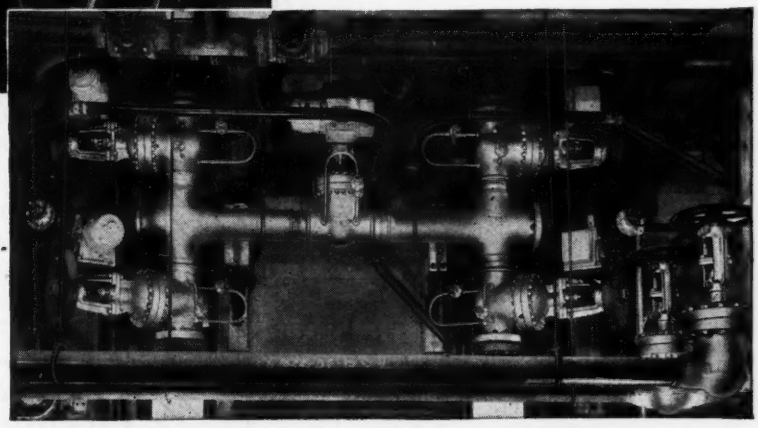
The same rigid control applied in making Crane valves and fittings marks every pipe shop operation. From raw materials to finished assemblies, one high standard of quality is maintained by the most elaborate facilities in the industry. Your complete satisfaction with every job is assured by Crane Co.'s 89-year leadership in the piping equipment field.

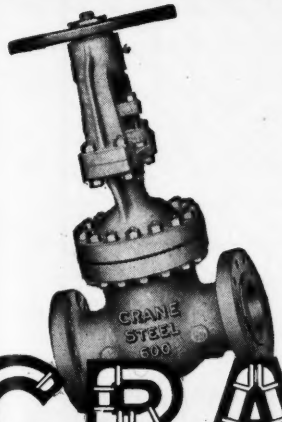
Crane Co., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*

2. IN THE FABRICATING SHOP — *All designs are completely fabricated by Crane. Proper selection of all parts is assured by the complete Crane line. One responsibility covers all materials and workmanship.*



3. ON THE JOB—*With Crane materials and Crane craftsmanship in every part, one standard of quality guards the entire assembly. Shown is the completed 12 x 8 x 4 in. header assembly of 600-pound cast steel motor-operated gate valves and fittings, installed in a central station.*





CRANE

VALVES • FITTINGS • PIPE
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Constant ignition is maintained electrically, so that if shut off by any of the safety devices, the fire will relight automatically when normal conditions are restored. Full automatic controls are provided and the unit is designed to make steam from cold start in 2 min. Space is lacking here for a full description of operation but it is given in the company's literature. Full operating and maintenance instructions for this unit are also given in Diesel Locomotives (Mechanical Equipment) by John Draney, published by American Technical Society, 58th & Drexel, Chicago, Ill.

Another small steam generating unit, the Clayton or Kerrick-Kinetic steam generator, is built by the Clayton Mfg. Co., Alhambra, Calif. Although this unit is built in the capacity range required—10 to 150 boiler horsepower or approximately 300 to 4500 lb per hr —it is now built only for pressures of 10 to 150 psi. The company states that after its war work is over it may build them for higher pressures.

These Clayton units also are of the forced-circulation, once-through type, fired by oil or gas, with full automatic control. They have been installed in laundries, kitchens, plating and vulcanizing plants, for sterilizing work and so on. They are designed to attain full pressure from cold start within 5 min and are, of course, entirely self contained. Like the Vapor Clarkson unit, they use recirculation to minimize clogging of the coils, a steam separator, and full automatic regulation of fuel and combustion air.

The above is only a sketchy account of the small high-pressure steam generator situation but to anyone interested it should indicate the sources of more detailed information.

How Determine Correct Suction Pressure on CO_2 Compressor?

Answer No. 256

IN THE April issue, A. T. K. asked if there is any set rule or chart that will give the exact suction pressure to carry on a CO_2 compressor in a theater air-conditioning plant, so he can conserve as much fuel and power as possible.

Suction Pressure Depends on Temperature

CORRECT SUCTION PRESSURE for any refrigerating system can and should be determined by the tables for that particular refrigerant. In the case of CO_2, first determine the temperature that is to be carried on the system and from the table of properties of carbon dioxide find the correct pressure for that temperature. These tables can be found in any refrigeration textbook or bought separately by writing to Lefax, Inc., 9th & Sansome Sts., Philadelphia, Pa. for paper No. 34-32. The price is about 20 cents.

Baltimore, Md. CHAS. W. PARKS

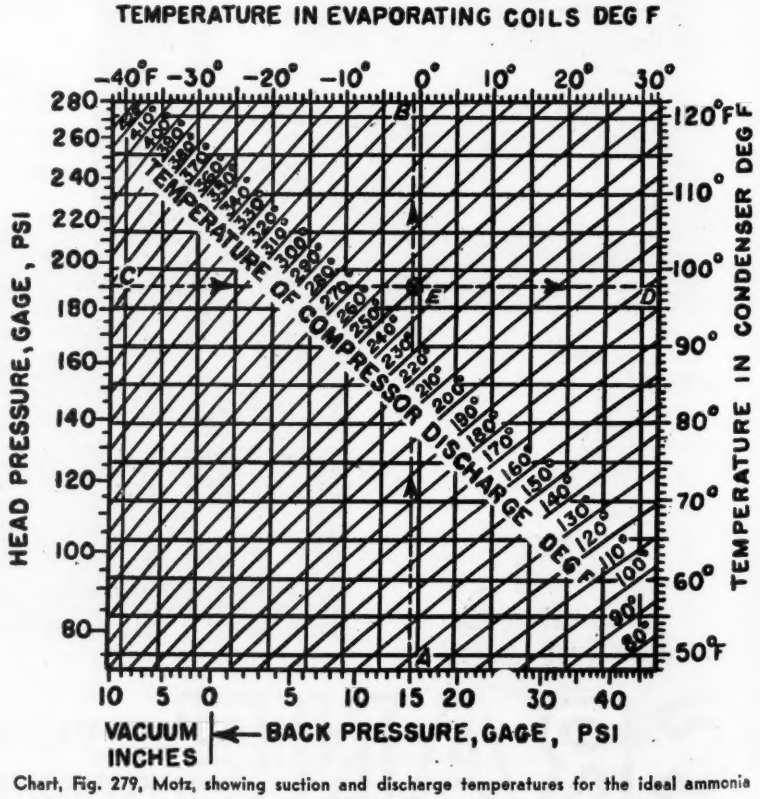
EDITOR'S NOTE—It wouldn't surprise us to find there is much more behind this apparently simple question and its perfectly simple answer. We wonder if the thing that really bothers A. T. K. is to find out what his suction temperature and pressure ought to be to produce the air conditions he wants in his theater. This pressure and temperature naturally depend on the temperature, humidity, cleanliness and circulation of air he is required to maintain in the theater under varying conditions of occupancy, outdoor air conditions and the like. Variations in these factors can, of course, be measured and calculated if suitable data are obtained by use of the necessary dry and wet bulb thermometers, indicating and recording pressure gages, observations of air circulation, calculation of air flow and the like. The various factors are discussed in the standard textbooks and handbooks. The final result, so far as the CO_2 compressor is concerned is that under a given set of conditions, it will require a particular suction temperature in the CO_2 system to maintain them and this temperature will vary with the conditions.

To amplify Mr. Parks' reply and give some indication of the pressure and temperature relations, both in the suction and discharge sides, and their effect in securing most economical compressor operation, we give here some comments extracted from Chapter XX, Principles of Refrigeration by William H. Motz, 3rd Edition, published by Nickerson & Collins Co., Chicago, Ill. Also included are the two charts Mr. Motz refers to, taken from his book. His comments relate to the operation of both NH_3 and CO_2 compressors, hence the necessity for two charts.

Mr. Motz points out that both suction and discharge pressures should be measured with accurate, sensitive, rugged thermometers, properly located and installed and pressure gages preferably of the recording type. By proper use of their readings, both discharge and suction sides can be analyzed for best operation. Leakage of valves and refrigerant, improper operation of valves, accumulation of dirt on evaporating coils reducing heat transfer, and other troubles will be readily found with the help of these measurements.

The suction temperature must be held at a value that will produce the desired air conditions. Proper regulation of the discharge temperature is also an important consideration for most economical operation, says Mr. Motz, although if suction temperature and pressure are right, discharge temperature will take care of itself. After discussing the various conditions in the system as revealed by proper temperature and pressure measurements of the refrigerant passing through it, Motz gives the following comments:

"A Guide to Correct Compressor Operation—Leakage in a compressor might go on for years running up the power bills and cutting down production, and not be detected by the engineer. But it is a simple matter to have a constant indication of the correct performance of the machine. Fit a thermometer well in the discharge of the compressor, and it will tell, with the aid of the chart given in Fig. 279, just how good or how bad the performance



Chart, Fig. 279, Motz, showing suction and discharge temperatures for the ideal ammonia compressor

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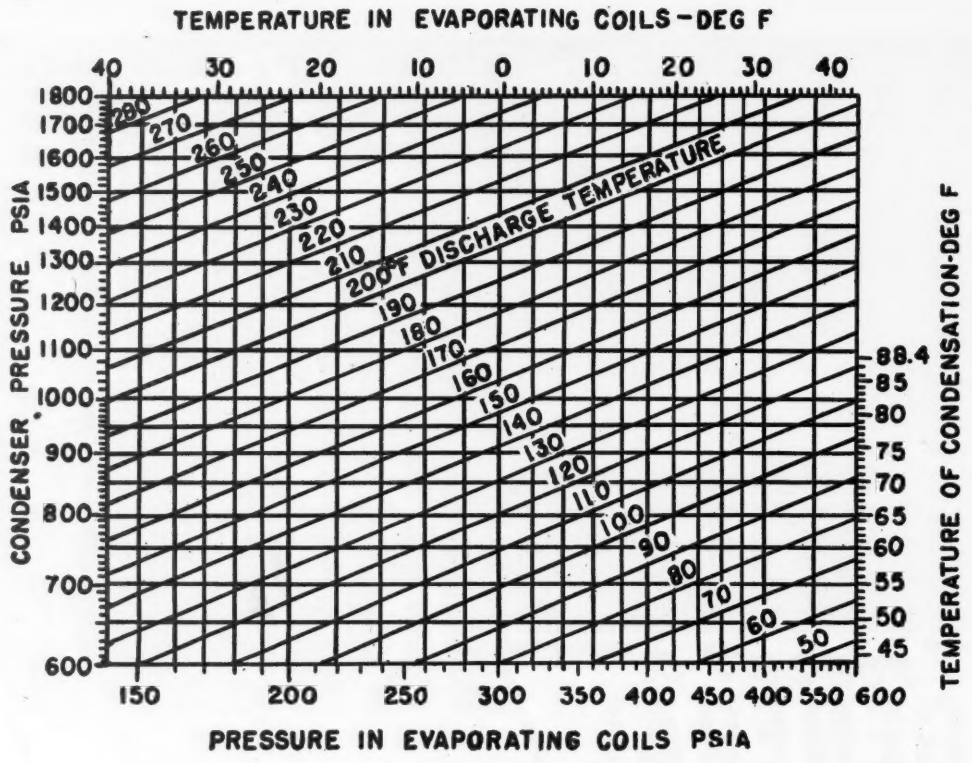

Chart, Fig. 280, Motz, showing suction and discharge temperatures of carbon dioxide compressor under ideal conditions

is that day. At the same time another thermometer should be installed on the compressor suction pipe, if one is not already there, in order to check up on the condition of the suction gas.

"Here are the reasons why the thermometer on the discharge tells such an important story. The temperature of discharge gas is high because each pound of gas compressed has received added heat energy just equal to the amount of work expended in its compression. If compression is efficient, the work is comparatively small. There is a correspondingly small rise in temperature during compression. If compression is less efficient, there is more work done on each pound of gas, and its temperature is correspondingly greater. Each of these causes inefficient performance, tends to increase the work done per pound of gas compressed, and hence to increase the discharge temperature.

"The diagram shown in Fig. 279 (for ammonia) gives the discharge temperature in an ideal compressor. Fortunately, in an actual compressor operating properly and normally, the discharge temperature is usually not far from what is shown by this chart. All compressors have their peculiarities, and each will show certain tendencies to give higher, or possibly lower, discharge temperatures than given by this chart. A change, such as a broken piston ring or chipped valve, will have an immediate effect on this discharge temperature.

"As an example of the use of this chart, suppose that we read gages and find the head pressure to be 190 lb and the back pressure to be 15 lb, and that the thermometer on the discharge reads 290 F, that on the suction reads 5 F.

"Referring to the chart, Fig. 279, find the point at the bottom for 15 lb back pressure, and from there draw a vertical line A-B to the top scale, where the temperature of evaporation may be read, which is minus one degree F. Hence the suction gas, as shown by the thermometer, is superheated 6 F.

"Next, find the head pressure, 190 lb, on the scale at the left, and draw the line C-D horizontally across the diagram. The point D on the scale at the right shows a condensing temperature of 90 F. Where the two lines intersect, E, notice the diagonal lines. E is between the two lines marked 250 and 260 deg and may be read 252 F. This is the discharge temperature of the ideal compressor. This particular compressor, we have assumed, showed a discharge temperature of 290 F, or 38 deg higher than the figure for the ideal compressor.

"This difference is more than there should be in a well designed compressor. If we had found a suction superheat of 20 or 25 deg, instead of only 6 deg, it would be sufficient to explain this high discharge temperature, but as it is, there is probably some other cause of high discharge temperature, such as:

Valves stick open or stick shut
Valve springs too heavy
Valve lift insufficient
Valves or seats injured and leaking
Piston rings broken
Piston rings so worn as to fail to press on walls
Ring slots in piston worn
Ring ends poorly fitted
Rings stuck in slots by deposits

No effective oil seal between rings and cylinder walls, producing leakage and fractional heat.

"There are, of course, conditions that may reduce the discharge temperature below that of the chart. For instance, the expansion valve may be so open as to cause some liquid to return to the compressor, perhaps as a spray or fog. This has a marked lowering effect on the discharge temperature.

"Engineers in certain parts of the world like to have such a liquid fog in the suction gas, and even go so far as to fit a small expansion valve to inject into the suction. It reduces the temperature of the cylinder and stuffing box, and so makes lubrication easier. Where this practice is followed it is common to regulate the liquid injection in accordance with the discharge of temperature. This has the objection, however, that with 'wet compression,' as this is called, there is no chance to detect leakage or other faults, as we have explained, by means of the discharge temperature, because any of these smaller effects are covered up by the greater effect of the liquid injection.

"All of the foregoing discussion has referred to ammonia compressors. Carbon dioxide compressors are often installed in hospitals, theaters and other public buildings. The same condition holds for them also, except that another chart is necessary. The data of carbon dioxide is not as exact as for ammonia, but the accompanying chart, Fig. 280, (for carbon dioxide) has been compared with practice and appears to have equal value for use in checking the performance of these compressors."

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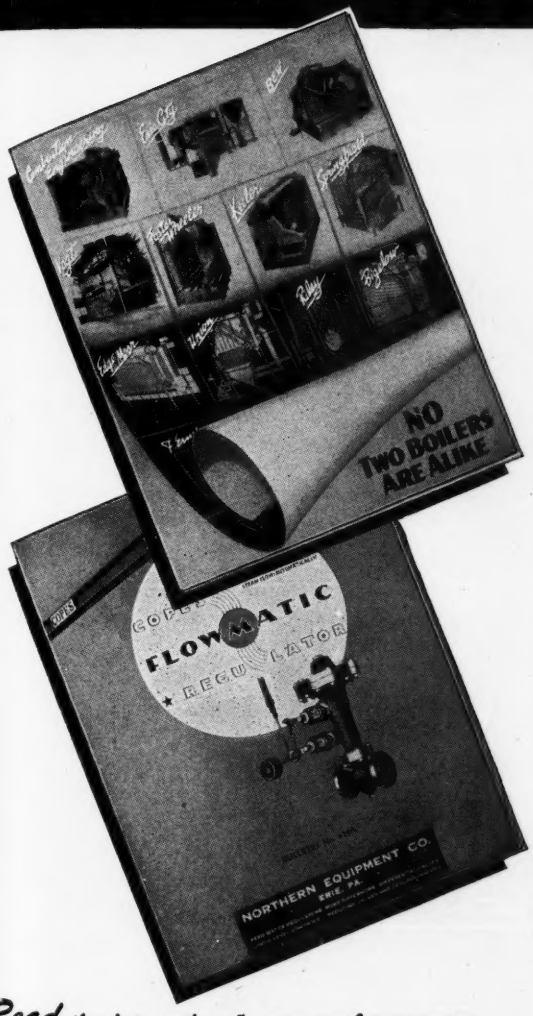

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6. Reduces tendency to swap loads among boilers of a battery.
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13. Available in both direct operated and relay operated types.
14. Flowmatic is a Copes Product—symbol of pioneering and leadership in feed water regulation.

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$\pi = 3.1415926536$	$\frac{\pi}{4} = 0.7854$	$\frac{1}{\pi} = 0.31831$	$\pi^2 = 9.96960$	$\sqrt{\pi} = 1.77245$
$\frac{\pi}{2} = 1.5708$	$\frac{\pi}{12} = 0.2618$	$\frac{1}{\pi^2} = 0.10132$	$\pi^3 = 31.00628$	$\sqrt{\frac{1}{\pi}} = 0.56419$
$\frac{\pi}{3} = 1.0472$	$\frac{\pi}{64} = 0.04909$		$\log. \pi = 0.4971499$	$\log. \sqrt{\pi} = 0.2485749$

$$\text{Diameter} = \frac{226 \times \text{Circumference}}{710}$$

$$\text{Circumference} = \frac{710 \times \text{Diameter}}{226}$$

$$\text{Diameter} = \frac{99 \times \text{Side Inscribed Square}}{70}$$

$$\text{Side Inscribed Square} = \frac{70 \times \text{Diameter}}{99}$$

$$\text{Diameter} = \frac{70 \times \text{Side of Equal Square}}{79}$$

$$\text{Side of Equal Square} = \frac{79 \times \text{Diameter}}{70}$$

$$\text{Circumference} = \frac{39 \times \text{Side of Equal Square}}{11}$$

$$\text{Side of Equal Square} = \frac{11 \times \text{Circumference}}{39}$$

$$\text{Diagonal of Square} = \frac{99 \times \text{Side of Square}}{70}$$

$$\text{Side of Square} = \frac{70 \times \text{Diagonal of Square}}{99}$$

$$\text{Area of Circle} = \frac{322 \times \text{Area of Inscribed Square}}{205}$$

$$\text{Atmospheres} = \frac{23 \times \text{Feet of Water}}{780}$$

$$\text{Feet of Water} = \frac{780 \times \text{Atmosphere}}{23}$$

$$\text{Pounds per Sq. Inch} = \frac{29 \times \text{Feet of Water}}{67}$$

$$\text{Feet of Water} = \frac{67 \times \text{Pounds per Sq. Inch}}{29}$$

$$\text{Pounds per Sq. Foot} = \frac{51 \times \text{Kilograms per Sq. Meter}}{249}$$

$$\text{Kilograms per Sq. Meter} = \frac{249 \times \text{Pounds per Sq. Foot}}{51}$$

$$\text{Inches of Mercury} = \frac{57 \times \text{Pounds per Sq. Inch}}{28}$$

$$\text{Pounds per Sq. Inch} = \frac{28 \times \text{Inches of Mercury}}{57}$$

$$\text{Inches of Water} = \frac{720 \times \text{Pounds per Sq. Inch}}{26}$$

$$\text{Pounds per Sq. Inch} = \frac{26 \times \text{Inches of Water}}{720}$$

$$\text{Feet of Water} = \frac{60 \times \text{Pounds per Sq. Inch}}{26}$$

$$\text{Pounds per Sq. Inch} = \frac{26 \times \text{Feet of Water}}{60}$$

$$\text{Inches of Mercury} = \frac{15 \times \text{Feet of Water}}{17}$$

$$\text{Feet of Water} = \frac{17 \times \text{Inches of Mercury}}{15}$$

PRACTICAL ELECTRICAL FORMULAE FUNDAMENTALLY DERIVED

R = Resistance in ohms.
I = Current in amperes.
E = E.M.F. in volts.
W = Watts.

$$R = \frac{E}{I} = \frac{W}{I^2} = \frac{E^2}{W} \qquad I = \frac{E}{R} = \frac{W}{E} = \frac{1}{\sqrt{\frac{W}{R}}} \qquad E = \frac{W}{I} = IR = \frac{1}{\sqrt{WR}}$$

$$W = EI = I^2R = \frac{E^2}{R}$$

RELATION OF HORSEPOWER TO ELECTROMAGNETIC UNITS

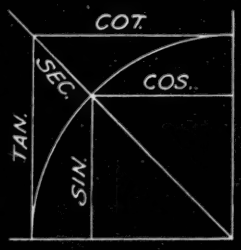
Since 1 watt equals 1/746 of a horsepower, the relations are as follows:

$$\text{H.P.} = \frac{W}{746} = \frac{EI}{746} = \frac{I^2R}{746} \qquad \text{H.P.} = \frac{\frac{E^2}{R}}{746} = \frac{\text{K.W.} \times 1{,}000}{746}$$

$$\text{K.W.} = \frac{\text{H.P.} \times 746}{1{,}000}$$

FUNCTIONS OF ANGLES

	0°	30°	45°	60°	90°	180°	270°	360°
Sin.	0	$\frac{1}{2}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}\sqrt{3}$	1	0	−1	0
Cos.	1	$\frac{1}{2}\sqrt{3}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}$	0	−1	0	1
Tan.	0	$\frac{1}{3}\sqrt{3}$	1	$\sqrt{3}$	∞	0	∞	0
Cot.	∞	$\sqrt{3}$	1	$\frac{1}{3}\sqrt{3}$	0	∞	0	∞
Sec.	1	$\frac{2}{3}\sqrt{3}$	$\sqrt{2}$	2	∞	−1	∞	1
CSC.	∞	2	$\sqrt{2}$	$\frac{2}{3}\sqrt{3}$	1	∞	−1	∞



USEFUL FORMULAS

Reprinted from the Ehret Magnesia Manufacturing Company's "Insulation Manual".

The Power Plant News
FINAL
CHEMICAL ENGINEERS LOCATE MECHANICAL DIFFICULTIES
Tube Burn-outs Eliminated by Modification of Boiler Design

The amount of money saved by preventing boiler outages can be astonishingly large. For example, essential production in a large eastern paper mill was interrupted all too frequently by tubes burning out in a high pressure 4-drum boiler. Use and occupancy insurance cost the underwriters several thousand dollars for these outages. No immediate solution to the problem was apparent and Betz engineers were consulted.

A thorough study of the problem showed that satisfactory chemical balances were being maintained in the lime-soda softener and boiler water at all times. However, a detailed check of the boiler design revealed that incoming feed water was circulating directly to the hottest generating tubes with the result that rapid scale formation and cyclic disintegration in these tubes were responsible for the recurring burn-outs. A modification of the design for feed water delivery was recommended and adopted. Tube burn-outs ceased immediately.

Although this is a rather unusual case it nevertheless illustrates the breadth of experience behind the Betz organization for keeping boilers "on the line".

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ASME Discusses Wartime Problems

At its Semi-annual Meeting held in Pittsburgh, June 19 to 22 the American Society of Mechanical Engineers devoted most of its sessions to problems directly connected with the Government's program for winning the war. Aviation, metals, materials, heat transfer, management, fuels, and power were given places of prominence on the program

WITH TRANSPORTATION difficulties due to war conditions facing every out-of-town attendant at the engineering meetings, the advisability of holding such meetings has been questioned by many. It is, nevertheless, a fact that meetings of the kind held by the American Society of Mechanical Engineers in Pittsburgh on June 19 to 22 are being attended by a larger number of engineers than previous to the war. Nearly 1400 were registered at this Semi-annual Meeting.

Pittsburgh Post-Gazette Photo

Fig. 1. Igor I. Sikorsky receiving the Worcester Reed Warner medal for outstanding work in engineering from Robert M. Gates, ASME president, in the presence of R. J. S. Pigott and Henry F. Hebley

In the program at Pittsburgh the greatest emphasis was laid on problems having to do with the production of aviation equipment. The closely allied problems of metals and materials also received major attention. Wartime production problems, however, are not confined to a limited few branches of engineering and the program committee recognized this by providing sessions on industrial instruments, quality control, management, lubrication, fuels, heat transfer, power, material handling, hydraulics, engineering production and industrial furnaces.

Aviation

With the outbreak of the present war, the engineer's part in the aviation industry took on proportions far greater than had previously been anticipated and many new problems in design, materials and construction had to be worked out hurriedly, in many cases without experimental data to guide the engineer.

At this meeting those interested in aviation combined a number of their sessions with other divisions of the society in order to get the benefit of detailed experience in other industries. Thus the applied mechanics division joined in the discussion of the strengthening of circular holes in plates under edge load, the measures taken by the Materiel Command to insure the prevention of flutter in Army Air Forces airplanes, and the bending rigidity and column strength of thin web sections.

Aviation engineers also joined in discussions of their problems with those interested in industrial instruments and regulators, petroleum, the wood industries, metals engineering, rubber and plastics. Their interests were high-lighted at the dinner on Wednesday evening by the address of Igor I. Sikorsky on the subject "Direct Lift Aircraft."

Mr. Sikorsky, who is primarily responsible for the development of the helicopter, stated that his first objective in developing this type of aircraft was to provide a unit that could take off and land without the necessity of a large and expensive landing field. The speed of this type of aircraft will probably never exceed 120 to 140 mph but he visions units that will carry 12 to 20 persons. Motion pictures which he showed demonstrated the ease with which helicopters can be maneuvered.

Study was given by the engineers interested in materials to the cutting of metals, creep tests, joints in aluminum, induction furnaces, materials used in the railway industry, the use of plywood, controlled atmospheres for metal processing, material handling, rubber and plastics.

Fuels

Consumers of fuel have been forced by the demands of the war industries to a realization that our national reserves of oil, gas and solid fuels are not unlimited, and E. C. Payne appeared before the engineers with a plea that before a power plant is designed the fuel which it will use should be thoroughly investigated. Such an investigation requires a complete study of all fuel resources, it must go much deeper than a price and quantity inquiry. Specialists in combustion, coal production, and fuel transportation should be consulted to establish the facts which must be considered in selecting the equipment, the fuel, and the site of a new power plant. The quality and characteristics of the economically available coals should thus be used as the basis for the design of the combustion equipment that will use these coals efficiently and produce steam at a competitive cost.

One of the least appreciated causes of boiler furnace troubles is the segregation of coal as it is delivered to the fuel bed. Just how this takes place with various types of equipment and methods of delivering coal to stoker hoppers was discussed in a paper by Arthur J. Stock, who for many years has specialized in the design of non-segregating coal chutes. His paper is of such interest to power engineers that an abstract is printed on other pages of this issue to which the reader is referred.

During recent years, engineers have been operating their boiler furnaces at higher temperatures, thus enabling them to carry higher loads. This practice has caused some trouble with the accumulation of slag on furnace wall tubes and considerable research work has been carried on to find means for preventing this slag accumulation from reducing the heat transfer from the furnace to the water in the boiler.

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Fig. 2. C. M. Laffoon, author of paper on power trains, T. E. Percell, chairman of the second power session, and C. C. Franck, speaker on turbine research

Among the research scientists working on this problem are W. T. Reid and P. Cohen, both connected with the Experiment Station of the Bureau of Mines located at Pittsburgh, who reported on their most recent work of determining the factors affecting the thickness of slag on furnace water tubes, with principal emphasis directed toward determining the fundamental properties of coal-ash slags at high temperatures.

The authors reviewed the information included in a forthcoming technical paper of the Bureau of Mines in which the subject is treated in considerable detail and in which the mathematical derivations of the complex relationships are given. It was stated that the study of slags has furnished data from which the thickness of slag deposits can be calculated for idealized conditions.

Increase in equivalent Fe_2O_3 content and decrease in ferric percentage decrease the thickness of the deposits; CaO also decreases the deposit thickness as its content increases, the effect being greatest with slags containing less than 20 per cent equivalent Fe_2O_3.

Fuel conservation is a subject that is absorbing the interest of all power engineers throughout the country and it was reported by J. F. Barkley, of the U. S. Bureau of Mines, that the Government is working on four projects in order to help relieve the huge and growing surplus of industrial sizes of anthracite that threatens to cut vitally needed production of domestic sizes unless new markets can be found, and to supplement the available supply of industrial sizes of soft coals to help meet the growing needs of war plants and other industries. The four projects are: Burning mixtures of small anthracite and bituminous slack on stokers; methods of production and burning of "packaged fuel" made from anthracite fines; the use of anthracite fines in the production of coke; and the use of barley anthracite in gas producers.

The effects of combustion on underfeed stokers of adding anthracite to bituminous slack coal can be somewhat anticipated from a study of the factors involved. The barley coal particle is hard, slow burning, and non-caking. The bituminous coal in the eastern region of anthracite availability is, in general, a caking coal with a considerable range of volatile, of ash, of Btu content, and of ash fusion.

The author reported that there has been a phenomenal growth in the use of packaged fuel during the last seven or eight years, its development having been due chiefly to the demand for a method of making use of the fine coal produced at docks or coal yards, resulting from the rescreening and sizing of coal for domestic use. In experimenting with various mixtures of anthracite fines and bituminous coals, the author reported that no major difficulties had been experienced in the manufacture of blocks from these mixtures, but much study must yet be made to summate satisfactorily the large amount of data taken on tests in the commercial plant and at the Pittsburgh Station of the Bureau.

A market for not less than 300,000 tons of barley might be developed, as a result of experiments now in progress for the substitution of barley in place of the larger sizes of anthracite now used in gas producers. In these experiments a fuel bed agitator in a Wellmen Galusha producer is in use at a plant in the eastern area. The Bureau of Mines hopes that the agitator will prove to be a means of opening additional markets for a large tonnage of barley.

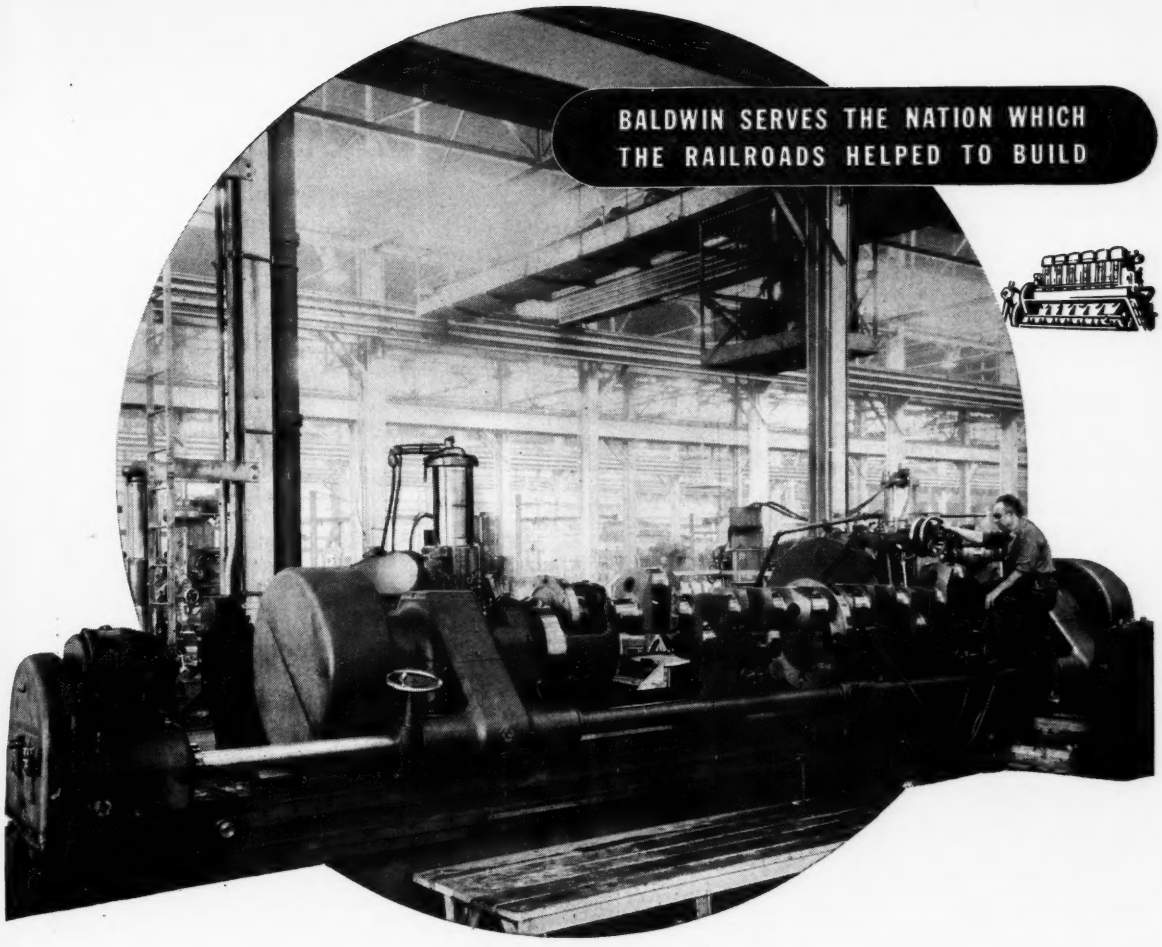
Heat Transfer

Although four sessions were held under the heat transfer division of the Society, only a few of the papers were devoted to subjects in the power field. One of the most interesting of the sessions was a panel discussion on recent developments in industrial furnaces. It was clearly evident from the discussion that the art of preparing metals for industrial uses has gone a long way since the development of the induction furnace and that much yet remains to be done in the way of furnace construction of special metals before engineers in the industry will feel that their problems are satisfactorily solved.

Rapidly expanding use of water cooling towers during the war emergency has demonstrated the need for a more thorough knowledge of the methods of calculation of tower performance. With this thought evidently in mind, N. T. Peet presented equations which give satisfactory correlation of the variables involved in the operation of the counter-current flow type of towers. It was stated that, as yet, no satisfactory method has been made available for the analysis of towers employing the cross-flow principle. It was the purpose of this paper to present what was believed to be a satisfactory approach to the problem of evaluating the performance of cross-flow towers. The method of treatment is developed from the Merkel differential equation for counter-current towers. In an appendix to the paper, the author gave a solution to a problem illustrating the use of the equation developed in his paper for this purpose.

In a paper dealing with the variable heat transfer rate correction in multipass exchangers shell side film controlling, Karl A. Gardner stated that the change in temperature of the fluid streams within a heat exchanger, through the consequent alteration of their physical properties, may cause the overall heat transfer coefficient to vary between rather wide limits; this represents the chief source of error in mean temperature difference formulas, most of which are derived on the assumption of constant overall coefficient. A. P. Colburn based a simple method of correcting for this effect in counter and parallel-flow exchangers on the assumption of a linear variation of rate with fluid temperature.

On this same basis, equations were developed by the author in the present paper for multi-pass exchangers in which the shell fluid film controls. It was shown that the results are prac-



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Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings. Briquetting presses.

BALDWIN
DIESEL ENGINES

Here is one of the reasons why your Baldwin Diesel engine will give you something more in economy, service and all-round satisfaction.

It is one of the world's largest crankshaft grinders, recently installed to finish an essential part of the engine to within one ten-thousandth of an inch—plus or minus—of designed dimensions, and, at the same time, insure accurate parallelism.

A trip through the Baldwin shop would show you many examples of this emphasis on ultimate quality and accuracy—skilled craftsmen who know how to do a *plus* job . . . and machines that help them to do it.

This means extra work and expense . . . but when you purchase your next Baldwin Diesel, you'll recognize the fact that it also means better Diesel performance for you.

The Baldwin Locomotive Works, Locomotive & Ordnance Division, Philadelphia, Pa., U. S. A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston.

tically independent of the number of tube passes and the numerical data given were, therefore, those for the limiting case of cross-flow with both fluids mixed, since this proves to be more amenable to direct mathematical treatment. These data were presented graphically and in tabular form as correction factors by which the arithmetic average overall heat transfer coefficient and logarithmic mean temperature difference may be multiplied to obtain the true mean heat transfer coefficient-temperature difference product; an example of their use was given in the paper.

Power

Looking forward to the immediate post-war period, power engineers have worked out power plant designs that will enable those in devastated areas to be supplied with electric power within a few days after the arrival of the power equipment on the site where it is to operate. One of the sessions on power was given over entirely to the descriptions of the several types of power plants that have been designed and constructed for this type of service. At this session both the package-type power plants and power trains were described in detail, the former by H. H. Van Kennen and E. F. Wahrenburg of the Peter F. Loftus Organization and the latter by C. M. Laffoon of Westinghouse Electric & Mfg. Co., Otto DeLorenzi of Combustion Engineering Co. and F. G. Ely of Babcock & Wilcox Co.

These papers will not be briefed here but readers are referred to the abstract of the paper on packaged-type power plants printed on other pages of this issue, and to the several articles in the July issue of POWER PLANT ENGINEERING for details regarding power trains as developed by the several manufacturing concerns. Suffice it to say here that the attendance at this session was large and the discussion evidenced intense interest in the problems involved.

At another power session, the audience was held fascinated through an illustrated address delivered by C. C. Franck of the Westinghouse Electric & Mfg. Co., as he described the research methods used on steam turbines that have made it possible for the Allies to assemble many of the world's fastest and most powerful warships and merchant vessels to form the backbone of the 4000-ship invasion armada that took Allied troops to the shores of Normandy.

Among the research tools now available is the one-million-volt x-ray machine which has made it possible to discover flaws in the turbine castings. Some of the testing done in the laboratory has required pictures of blade vibration taken while the blade was moving at a speed of 600 mph in a steam atmosphere of 900 F. So large have the blades of turbines become that the principles used in the design of airplane propeller blades are applicable to turbine blade design.

Fig. 3. Alex D. Bailey, nominee for ASME president in 1945

Lubrication

In the field of lubrication, John Boyd and B. P. Robertson presented a paper dealing with their investigation of the friction properties of various lubricants at high temperatures. Report was made in their paper on some 24 different types of lubricants which were classified into the following groups: 1, mineral, animal, and vegetable oils; 2, mineral oil plus various additives; 3, fatty acid additives; 4, greases; and 5, solid lubricants.

One method of comparing the results for the different lubricants was on the basis of shearing stress as a function of the angular displacement. In general, the stress rose abruptly at first and then increased slowly as the angle of twist became larger. Minerals such as stearic acid, molybdenum disulfide and several others gave very flat curves which indicated an ability to maintain a lubricating film without being squeezed out.

The authors listed the lubricants tested in tabular form and rated them according to their average coefficients of friction. The lowest values were obtained with stearic acid which has a coefficient of 0.022 and the highest with powdered mica which has a coefficient of 0.257, representing a range of approximately 1:12.

Another report was made by R. G. Larsen and G. L. Perry on an investigation of friction and wear under quasi-hydrodynamic conditions in which the factors which influence friction and wear by additive containing mineral oils under conditions intermediate between those of hydrodynamic and true boundary lubrication were studied.

It was stated that the concentration of a number of sulphur and phosphorus compounds required for minimum wear varies over a wide range. The minimum effective concentration is determined by the presence in the molecule of acidic groups which concentrate the additive at the wearing surfaces. Organic acids were the only polar substances found which led to an appreciable reduction in friction. This is believed to be related to their ability to react with the metal surface. Marked simultaneous reduction of friction and wear was not achieved by using a combination of an antiwear and an antifriction agent. Under the conditions of the experiments conducted by the authors it appears that wear is predominately a corrosion process.

Nomination for 1945 Offices

During the meeting several sessions of the nominating committee were held at which members of the Society were invited to confer with the committee on the qualifications of proposed nominees for offices to be elected by letter ballot of all members of the Society, the election closing September 26, 1944. Those placed in nomination were:

For president: Alex D. Bailey. Mr. Bailey is a Fellow of the Society and is Vice-President in Charge of Operating and Engineering of the Commonwealth Edison Co., Chicago, Ill. He was born in Kenosha County, Wis., February 14, 1882. His formal education was secured in the grammar and high schools of Chicago and Glen Ellyn, Ill., and at Lewis Institute, where he received the degree of Mechanical Engineer in 1903. The honorary degree of Doctor of Science was conferred upon him at the dedication of The Technological Institute of Northwestern University in 1942.

He entered the employ of the Commonwealth Edison Co. in 1903 at Harrison Street Station, and progressed successively through the positions of Chief Engineer of Fisk and Quarry Stations, Superintendent of Generating Stations, Chief Operating Engineer, Assistant to the Vice-President, and since July 1, 1944, has been Vice-President.

Mr. Bailey has been interested in engineering education and was Chairman of the Board of Trustees of Lewis Institute for 3½ years and since the merger of that institute with Armour Institute in 1940 he has been Vice-Chairman of the Board of Trustees of Illinois Institute of Technology.

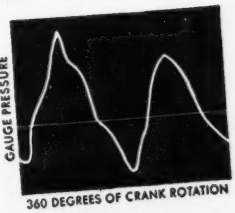
His interest in the ASME is evidenced by the various positions he has held in the Society since he became a Junior Member in 1910. He is still active on several important committees which have to do with either research or education and training.

For vice-presidents: David Larkin, vice-president and general manager of Broderick & Bascom Rope Co., St. Louis, Mo.; John Emerson Lovely, vice-president and chief engineer of Jones & Lamson Manufacturing Co., Springfield, Vt.; and Thomas S. McEwan, consulting management engineer of Chicago, Ill.

For managers: Daniel S. Ellis, vice-president in charge of manufacturing, Lima Locomotive Works, Inc., Lima, O.; Arthur J. Kerr, district manager of sales, Pittsburgh Equitable Meter Co., Tulsa, Okla.; and Herman G. Thielscher, mechanical engineer, Potomac Electric Power Co., Washington, D. C.

BURGESS MARINE SNUBBERS for Diesel Exhaust Noise Control

FIG. 1



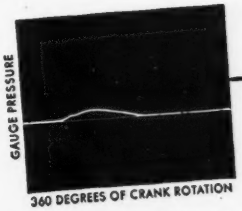


FIG. 2

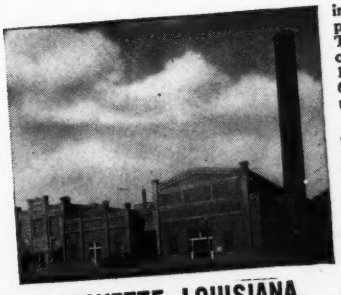
WHAT SNUBBING DOES TO A DIESEL EXHAUST

The noise of a Diesel exhaust is caused in part by the sudden expansion of slugs of gas as they are exhausted from the engine under relatively high pressure. The sudden impact of a slug of gas as it is vented to the atmosphere produces a loud concussion. These unimpaired slugs, of course, pour out of the exhaust pipe in rapid succession, and the resulting noise is deafening unless properly controlled.

A further cause of Diesel noise is the oscillation of pressure waves within the exhaust pipe. The main body of gases, traveling at high velocity, leaves the exhaust pipe with a resounding crack. Most of the gases shoot out leaving a partial vacuum in the cylinder and exhaust line. Atmospheric air flowing back into the partially evacuated pipe prevents the remaining burned gases from leaving the exhaust system. An oscillation is therefore set up which causes the characteristic Diesel exhaust roar.

In two-cycle engines, an excessive amount of burned gases may be forced back into the cylinder and cause the engine to work inefficiently. Frequently a free Diesel exhaust, unless tuned with the proper length of exhaust pipe, will interfere with scavenging. Fig. 1 shows a pressure curve of a free (unsnubbed) Diesel engine exhaust. Uncontrolled, there are wide variations of pressure. The resulting oscillations of pressure (shown by the jagged curve) create exhaust noises which are extremely disturbing.

The Burgess snubbing principle goes to the source of exhaust noise by snubbing the slugs of exhaust gases before any noise can occur. This is accomplished by spreading out the slugs and dissipating their kinetic energy before they reach the atmosphere. The slug enters the first section of the snubber—expands and loses much of its energy. Each of the remaining two snubbing sections dissipates the slugs still further so that the exhaust gases enter the atmosphere in a relatively steady flow. In addition, there can be no harmful reflected pressure surges to oscillate in the exhaust pipe to create additional noise and interfere with engine efficiency. Fig. 2 shows a pressure curve of the exhaust of the same Diesel engine when a Burgess Snubber is used. The exhaust slugs are dissipated, hence, there are no resultant noise-making surges.



LAFAYETTE, LOUISIANA, MUNICIPAL POWER PLANT

The first municipal power plant in LaFayette, La., was put into operation about 45 years ago. It consisted of two steam generating units of a combined capacity of 300 horsepower.

To keep pace with the demand of its increased population, the LaFayette power plant has grown in size and capacity. Today, four big Diesels developing a total of 4,250 hp produce a monthly output of 1,100,000 kw hrs. Two smaller Diesels of 600 hp each, purchased some years ago, are used for stand-by service.

The newer additions to the plant consist of two 1,400 hp, 8-cylinder, 16 x 20, 2-cycle, pump scavenged Fairbanks-Morse Diesels, each with a 1,000 kw generator. These F-M Diesels develop 1,400 hp at 300 rpm.

These big Diesels are quieted by Burgess Snubbers. A Burgess Air Intake Snubber is used to snub the incoming pulses of air without choking the intake pipe. This prevents the intake noise usually present with large Diesels. Loud exhaust noises are eliminated with a Burgess Exhaust Snubber by dissipating the exhaust slug before it reaches the outside atmosphere.

By using both Burgess Intake and Exhaust Snubbers, noise is eliminated without lessening the efficiency of engine operation. Such quieting of Diesel engines is provided in power plants all over the country, wherever Burgess Snubbers are used.

HELPFUL HINTS

SAI Intake Snubber

O-F Air Cleaner

DON'T OVERLOOK AN INTAKE SNUBBER AND AIR CLEANER

A Diesel engine must breathe freely. Any "choking" of the air intake impairs engine efficiency. A Burgess Snubber smooths the flow of intake air without "choking" the intake pipe.

An intake snubber should be used to smooth the flow of intake air and to level off high peak air intake velocities of pump scavenged 2-cycle engines. Otherwise oil pull-over may take place, creating additional filter maintenance problems.

Air filters require frequent servicing—at least twice a week. Care should be taken to see that the air filter is placed where servicing can be easily done.

Published by BURGESS-MANNING COMPANY Chicago, Illinois

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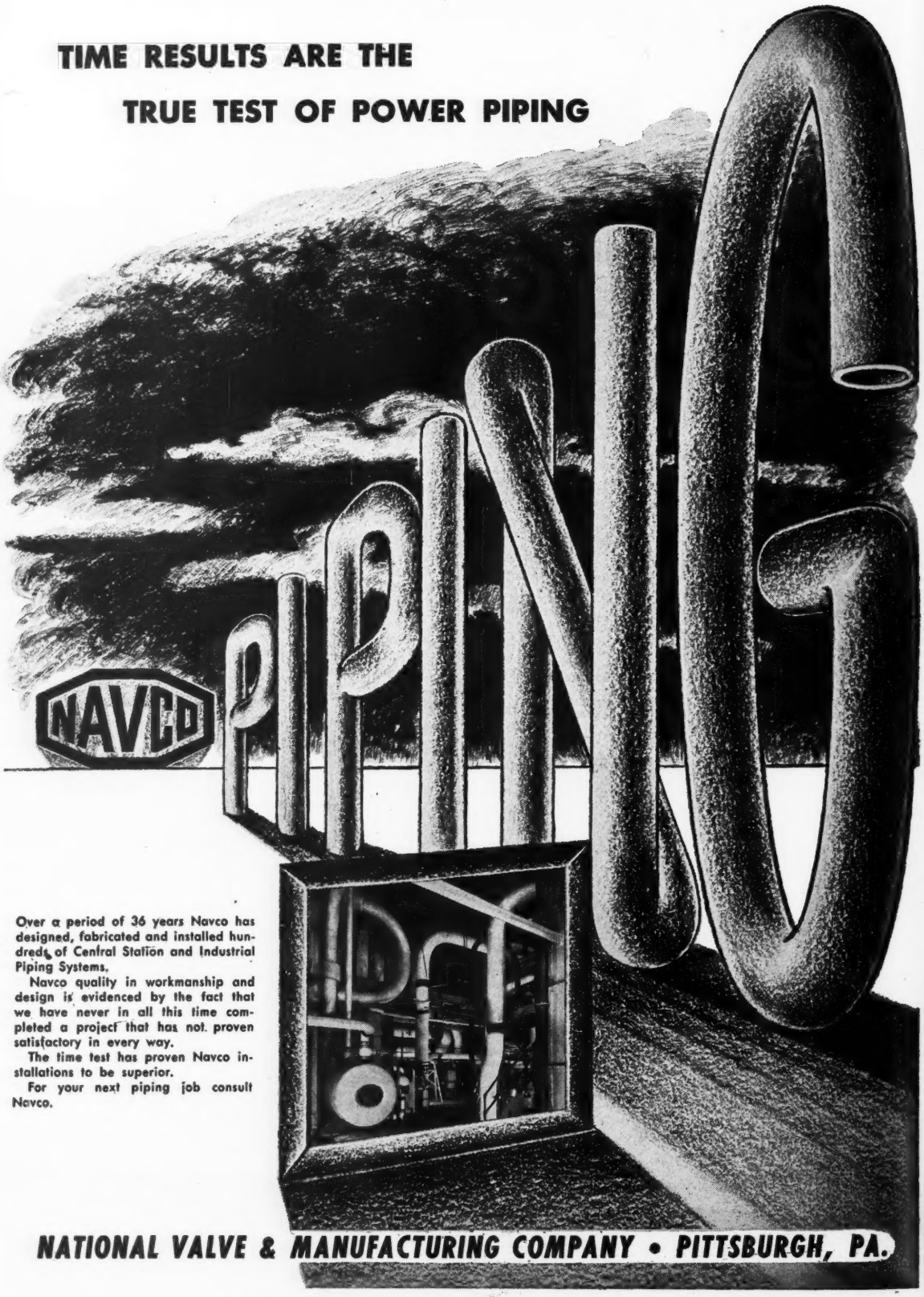
GESS—ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINA
COMPLETE SATISFACTION IN EXHAUST AND INTAKE QUIETING—SPECIFY BURGESS SNUBBERS—FOR COMP

TIME RESULTS ARE THE TRUE TEST OF POWER PIPING



Over a period of 36 years Navco has designed, fabricated and installed hundreds of Central Station and Industrial Piping Systems.

Navco quality in workmanship and design is evidenced by the fact that we have never in all this time completed a project that has not proven satisfactory in every way.

The time test has proven Navco installations to be superior.

For your next piping job consult Navco.

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

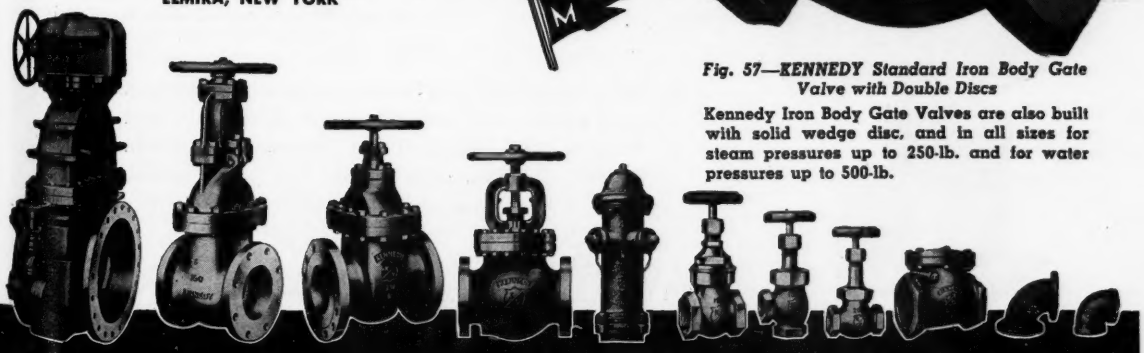
STURDY IN EVERY PART

Look at any Kennedy Valve in your dealer's stock . . . notice the generous proportions of body stem, flanges, bolts and hand-wheel. If you take a Kennedy Valve apart, you will find similarly substantial stem-operating mechanism and stem contact threads. The entire valve looks sturdy and is sturdy. You are always safe when you buy Kennedy Valves, whether gate, globe, angle or check types in iron body or bronze.

THE KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK

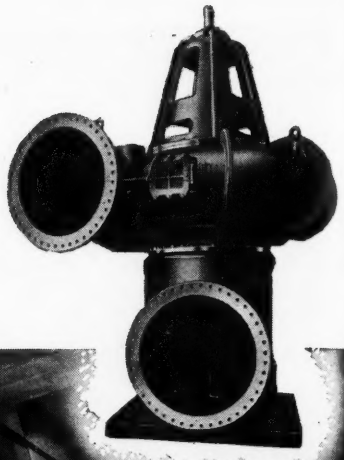
Fig. 57—KENNEDY Standard Iron Body Gate Valve with Double Discs

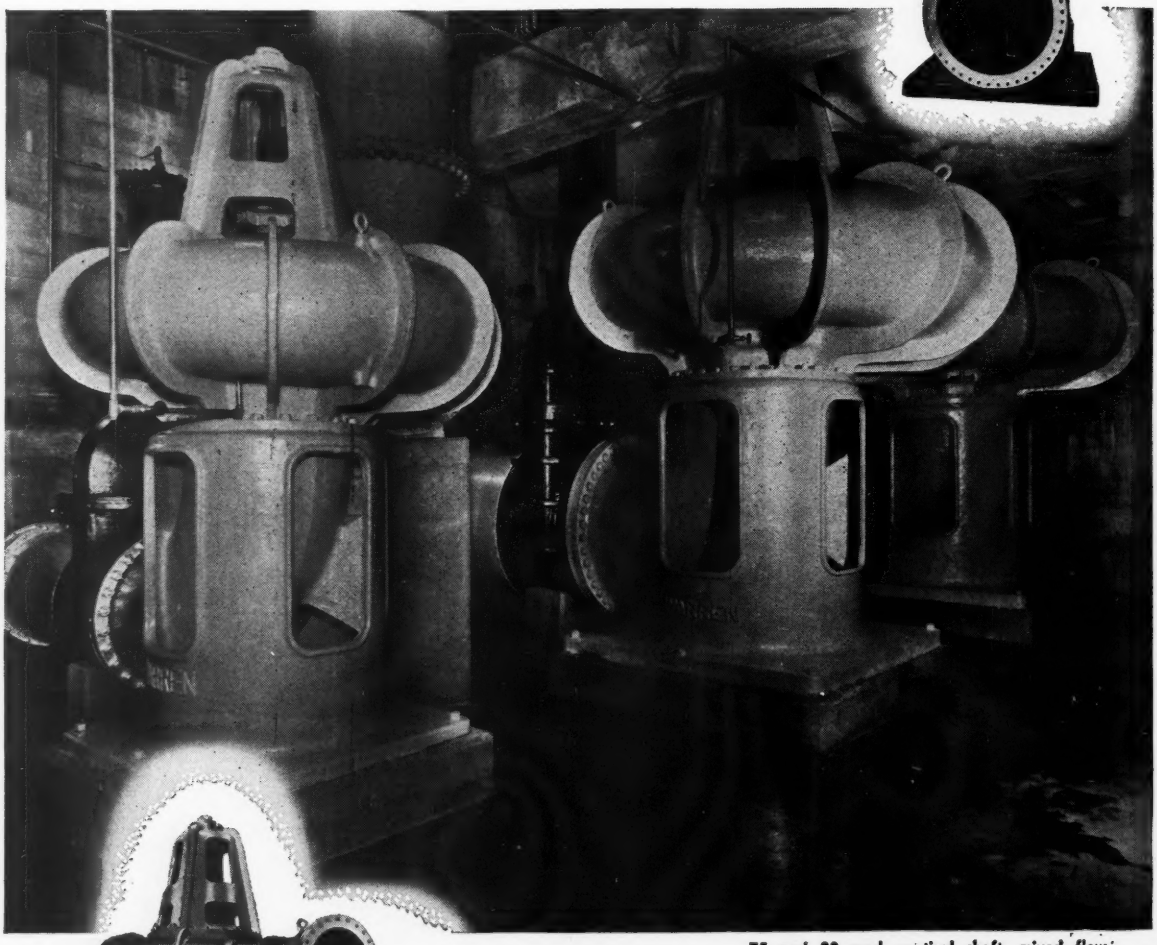
Kennedy Iron Body Gate Valves are also built with solid wedge disc, and in all sizes for steam pressures up to 250-lb. and for water pressures up to 500-lb.

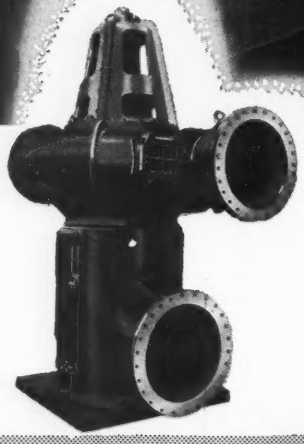


KENNEDY *valves . . . pipe fittings . . . fire hydrants*

PUMPS AGAINST THE RIVER AT SPRINGFIELD







75 and 30 mgd, vertical shaft, mixed flow Warren Centrifugal Pumps

Today versatile Warren Pumping equipment is serving in many fields . . . both ashore and afloat . . . and doing a good job at it! The Warren Pumps shown are part of fifteen units supplied City of Springfield, Mass., in connection with Flood Control and Sewage Disposal Project.

Whatever the service,
"A Warren Recommendation is Never a Compromise"

WARREN STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

MIDWEST PIPING & SUPPLY CO., INC.

Announces Acquisition of Control of

THE LUMSDEN & VAN STONE CO.

South Boston

PROVIDING ENLARGED AND IMPROVED FACILITIES FOR PIPE FABRICATION AND ERECTION IN NEW ENGLAND

THE Lumsden & Van Stone Company—fabricators and erectors of piping since 1898—has been purchased by Midwest Piping & Supply Co., Inc. As a result, the plant in South Boston has been enlarged, new equipment installed, and the organization expanded. Also available through this subsidiary is the accumulated experience of the nationwide Midwest organization in the fabrication and erection of power and industrial piping for all operating conditions.

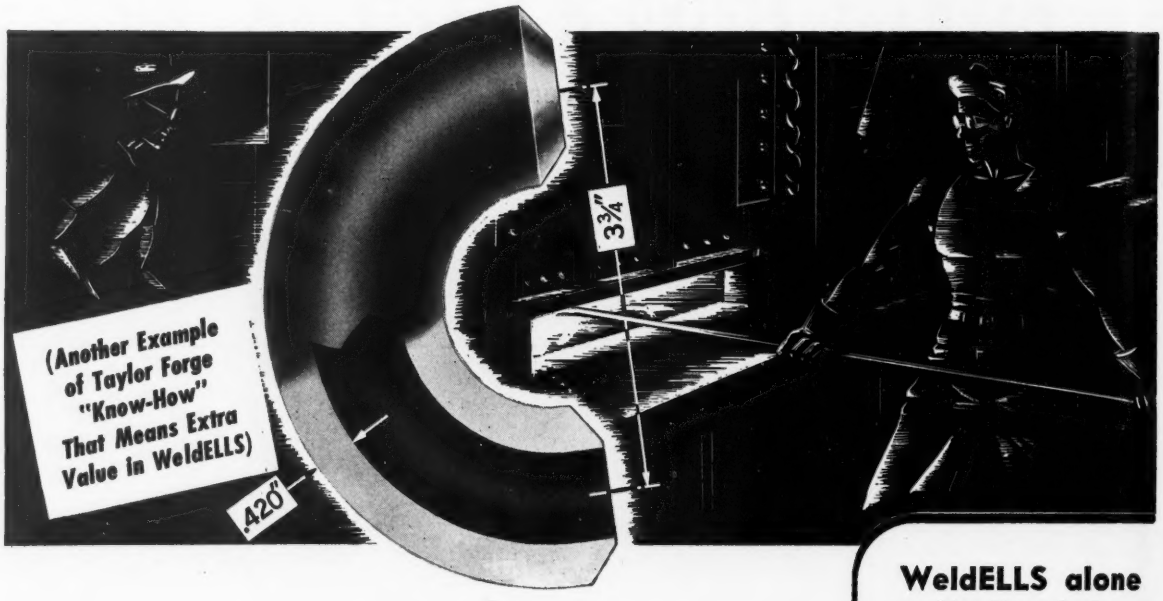
MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles
Subsidiary: Lumsden & Van Stone Co., South Boston, Mass.
Sales Offices: New York (Eastern Division)—30 Church St. • Chicago—645 Marquette Bldg. Los Angeles—520 Anderson St. • Houston—229 Shell Bldg. • Tulsa—533 Mayo Bldg. Atlanta—Red Rock Bldg. • South Boston—426 First St.

PIPING FABRICATORS AND CONTRACTORS . . . MANUFACTURERS OF WELDING FITTINGS

WHO ELSE COULD MAKE THIS?



●*As far as we know, no one else ever forged a fitting like the one pictured above—or any welding elbow or return bend having a wall thickness so heavy in proportion to the size of the fitting.*

Such fittings simply can't be made by the processes ordinarily employed in the manufacture of welding fittings. But a special method, developed and patented by Taylor Forge, makes them "duck soup" for us . . . . An excellent example, this, of the problems that are so often put up to us by engineers who feel we are a little better qualified to solve them than any other organization.

●It isn't likely that you will ever run into a condition calling for a fitting of this kind. We simply cite such problems to show you—far better than we can tell you—how much specialized knowledge has gone into our *standard* line of WeldELLS and other Taylor Forge welding fittings.

Do not underestimate the importance of this broad experience. In WeldELLS the "know-how" acquired in solving every conceivable kind of forging problem is reflected in features that are combined in no other make of welding fittings!

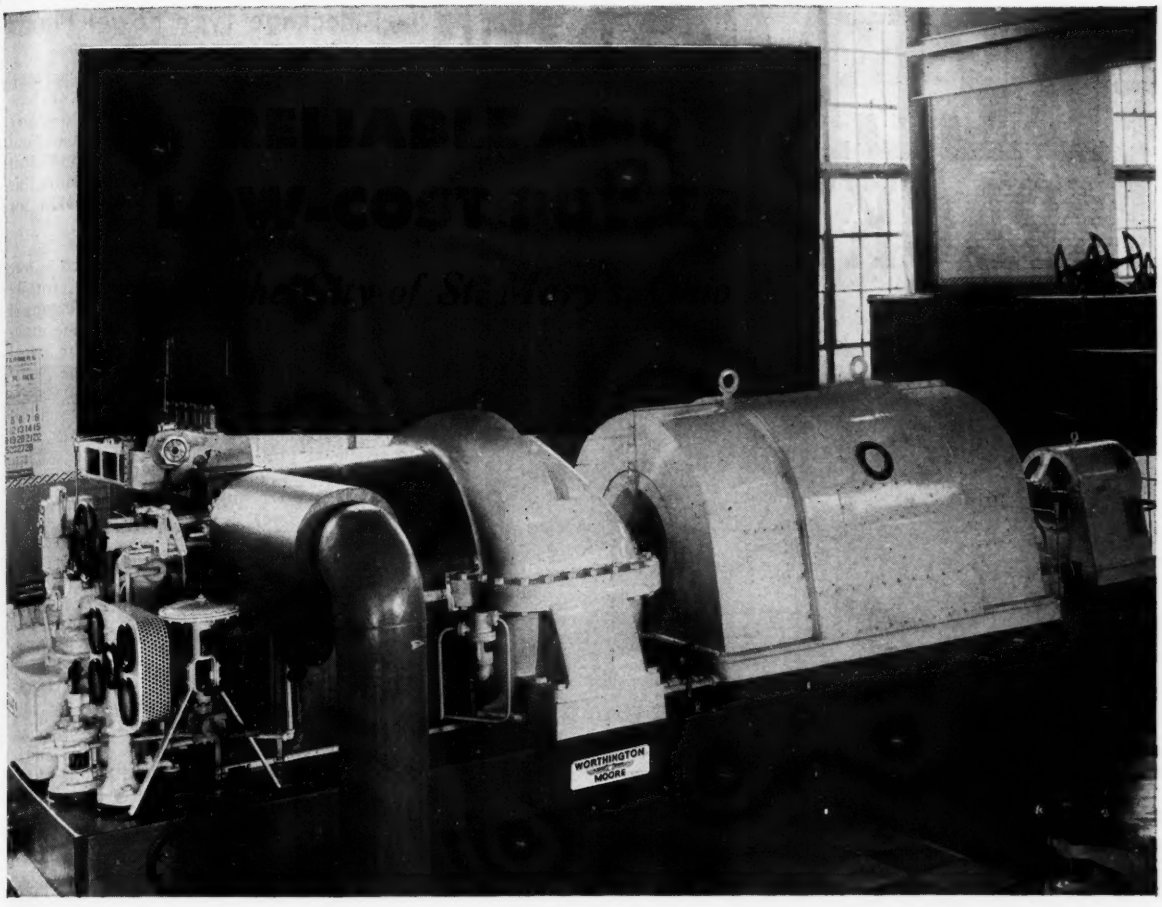
A good example of this is the selective reinforcement—extra metal properly distributed where stresses are greatest. Another is the tangents; another, the final truing operation which produces those extremely accurate dimensions. These, and the other features listed opposite, give you a better job of pipe welding at lower cost. Check over the list and we believe you will agree that

WeldELLS alone
combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS *have everything*

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



Municipal Power Plants, especially those serving vital War industries, must have reliable and efficient turbo-generators. A representative Worthington-Moore installation is shown above.

This 2500 KW Worthington-Moore turbo-generator unit is installed in the Municipal Electric Light Plant in the City of St. Mary's, Ohio. The turbine operates on steam at 400# initial pressure, 750°F. total temperature and exhausts to 28" vacuum. Altho it is rated at 3125 KW maximum at Unity power factor, the unit has carried loads as high as 3400 KW.

Making both single-stage and multi-stage turbines and turbo-generator sets . . . backed by Worthington's long experience in building equipment for the steam power plant, Worthington-Moore engineers are ready to study your power requirements and estimate your savings with a Worthington-Moore unit. Write us. Worthington Pump and Machinery Corporation, Moore Steam Turbine Division, Wellsville, N. Y.

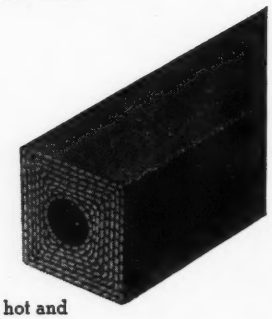
BEHIND THE NAME
WORTHINGTON
MOORE

PRODUCTS OF WORTHINGTON

AIR CONDITIONING EQUIPMENT • REFRIGERATION AND ICE PLANT EQUIPMENT • AIR AND GAS COMPRESSORS • STEAM TURBINES • DIESEL ENGINES • GAS ENGINES • CONVERTIBLE GAS-DIESEL ENGINES • CENTRIFUGAL HIGH-PRESSURE BOILER FEED PUMPS • DIRECT-ACTING STEAM PUMPS POWER AND ROTARY PUMPS • TURBINE WELL, SUMP AND DRAINAGE PUMPS • STEAM CONDENSERS AND AUXILIARIES • VACUUM PUMPS • STEAM-JET EJECTORS • WATER PURIFICATION EQUIPMENT • PORTABLE COMPRESSORS AND AIR TOOLS — For street . . . trench . . . conduit service V-BELT DRIVES • LIQUID METERS

BELMONT PACKINGS

BELMONT 9 . . . For all hydraulic services from low pressures to extremely heavy duty, hot and cold water.



BELMONT 319 . . . For hot and cold water rods and plungers.

FOR WATER

Belmont 319 Hollow Center Packing and Belmont 9 Special Hydraulic Packing will properly seal stuffing boxes of heavy hydraulic units such as presses, accumulators, draw-benches, squeezers and pressure pumps.

The hollow center of Belmont 319 Packing, provides a point of least resistance for expansion and extraction. Hence, the packing will "breathe" toward the "hole" as varying conditions of service within the stuffing box are exerted upon it.

Belmont 9 combines two distinctive materials made into one integral packing. The channel not only acts as a wiper, but as a protection to the inner body of flax . . . these two packings used in alternate rings make an ideal combination set.

Authorized Belmont distributors are located in every large industrial center to make recommendations on your requirements, or if you desire, a request on your company letterhead will bring a copy of the Belmont Catalog displaying the complete Belmont Packing Line in detail.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

Package Type Power Plants

(*Continued from page* 70)

sire to simplify foundation structures, and for the same reason the turbine oil reservoir and piping are held above the floor line. A continuous structural steel bed-plate is provided, of sufficient strength and of a design to permit this bed-plate to serve also as a skid for moving the unit.

Switchgear

The control panel is arranged in one unit, and is of the dead-front, totally enclosed, steel type. A substantial steel base is provided to facilitate moving it without distortion of the panel and enclosure. More than the usual number of outgoing feeder circuits are provided, as the distribution from this board is naturally indeterminate. The usual protective devices are provided, together with the necessary indicating voltmeters, ammeters, and the like, and a watthour demand meter is provided to measure the generator output.

A basic premise was that the load center would be close to the plant, and distribution is therefore at 400 v; however, some of the plants are provided with a 300-kva, 3-phase, step-up transformer to 6600 v.

Mounted within the cubicle of the switchgear unit is a 1000-watt gasoline-engine driven, automatically controlled, emergency lighting unit. The voltage of the lighting circuit is 230 v, and the normal lighting energy is brought direct from the generator winding from which all six terminals have been brought out. Thus, the necessity of any lighting transformer is eliminated. Upon failure of the main power unit, the emergency lighting unit will automatically respond within 15 sec.

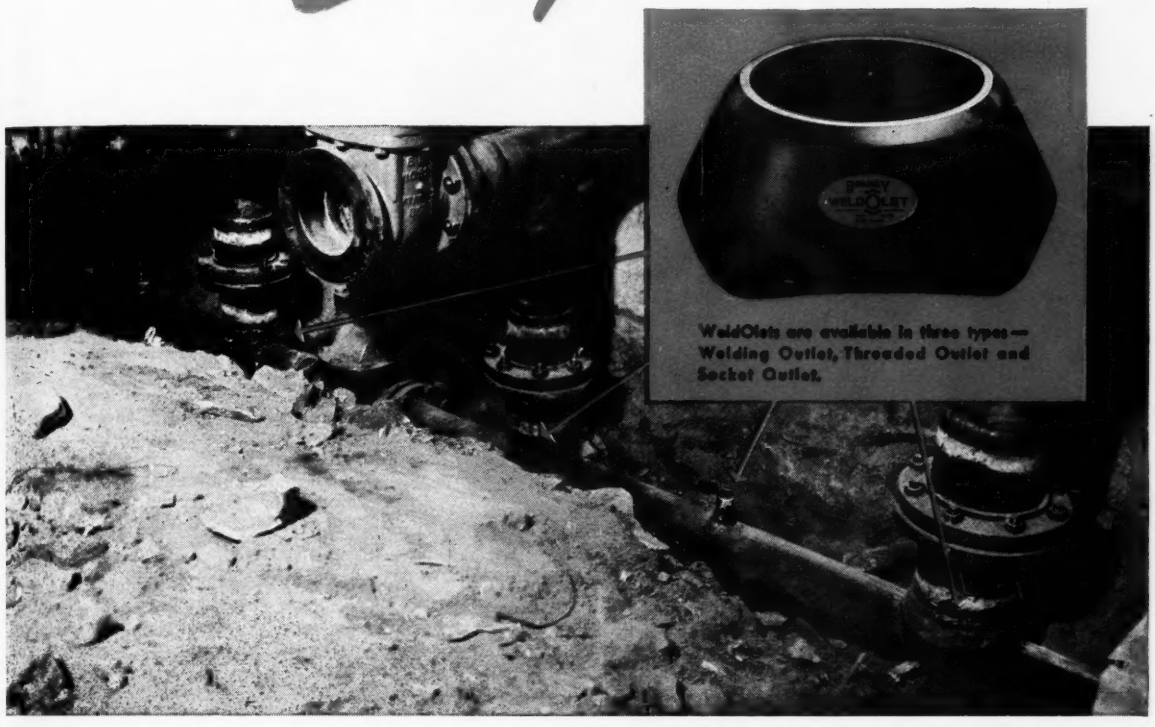
Condensing Unit

The condenser assembly, which consists of one package, was designed for mounting on a flat slab located at the same elevation as the turbo-generator. A substantial, structural steel base is provided, and the condenser (of a two-pass, surface type) is elevated above this base. Mounted on the base are motor driven condensate and circulating water pumps. The after-condenser and two single-stage air ejectors are compactly arranged at the side of the assembly. All the interconnecting piping between the elements of the unit is installed in operating position.

Spray Tower

The availability of a river or similar source of supply was not depended upon. A spray pond would place a large burden of work at the ultimate site in preparing an adequate and satisfactorily water-tight reservoir, while a cooling tower would involve a considerable quantity of intricate wood work assembly. A compromise was reached by selecting a spray tower, which simplified the wood work assembly and also reduced the foundation and concrete reservoir work to a minimum. As any and all wood work was to be supplied in the field, the spray tower equipment consists of the piping, spray nozzles, and the hardware necessary to assemble the wood

Difficult Branch Pipe Jobs made Easy by WeldOlets



WeldOlets are available in three types—Welding Outlet, Threaded Outlet and Socket Outlet.

If you have to make difficult branch pipe connections like these, it takes time and costs money. The WeldOlet method makes possible the installation of branch pipe outlets such as those illustrated above without removing the main pipe from the line.

A WeldOlet of the proper type is positioned on the pipe, tacked and welded in place before or after cutting the hole in the run pipe. The inside of the weld can then be inspected before the branch pipe is connected.

The result is a branch pipe outlet that insures full pipe strength. Flow through the pipe is smooth, with a minimum of friction and turbulence because of the funnel shaped opening in the fitting; freedom from weld icicles that might restrict flow; and maintenance of full inside pipe diameter.

WeldOlets have no equal for ease of installation on the really tough branch pipe jobs. The strength and rigidity that they give a piping system plus their highly efficient flow conditions justify their use wherever a branch pipe outlet is made.

WeldOlets are recommended for pressure values up to 400# steam pressure at 750° F. Size-to-size and reducing sizes are available from ¼" to 24". For complete information on types and sizes send for Bulletin WT31.

Forged Fittings Division* • BONNEY FORGE & TOOL WORKS • *639 N. Meadow St., Allentown, Pa.

WELDOLETS
TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets

Two Ground Bronze Seats

GIVE DARTS LONGER LIFE

If Dart Unions wore "hash marks," many now in service would be recognized as veterans of the last war.

Darts don't die on a job. Built with two bronze seats, ground to a true ball joint, they will hold a leakproof connection for a day or a decade—always ready to move on a moment's notice. That's why "close" buyers like them.

Next time you change piping, change to Darts. When you change piping thereafter, Darts will make the job easier.

Tell your supplier to send you some. They're handy to have in stock when minutes count.

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

work. All this material was conveniently combined in one case.

To meet a wide range of climatic conditions, with temperatures as low as 50 F below zero, provisions were incorporated in the design of the spray tower for segregating, recirculating, and the like, of various portions of the water. Screening also is provided.

Feedwater Assembly

The feedwater assembly consists of all the equipment necessary to the clarification, softening, treating, and heating of the boiler feedwater, as well as the feed pumps, and the required interconnecting piping, included in one package.

The essential elements of this assembly consist of: 1. A pressure filter of approximately 14 gpm capacity; 2. Two Zeolite softeners, each of 9 gpm capacity; 3. Two duplicate back-wash pumps, so arranged and interconnected that one can be utilized for delivering water to the filter in the event the raw water supply is of insufficient pressure, while the second can be utilized for back-washing both filters and softeners; 4. A spray type, deaerating feedwater heater of 12,000 lb per hr capacity, having in conjunction with it a ten-minute storage tank; 5. Two 40-gpm, non-cylinder-lubricated, steam-driven, reciprocating boiler feed pumps.

The exhaust steam from the boiler feed pumps goes direct to the deaerating heater, and is of sufficient quantity to maintain proper heater temperatures with the aid of a small amount of bleed from the high pressure system. The boiler water level is controlled by a control valve located in the steam line to the pumps rather than in the feedwater line, as is the usual practice. Saturated steam for the operation of the boiler feed pumps is taken direct from the boiler drum, to permit the use of cast iron cylinders.

Because of the possibility of low pressure in the raw water supply, there must be constructed at the site, and incorporated in the foundation slab, two concrete reservoirs of medium capacity; one to store a supply of raw water, and the other to accumulate a supply of clarified hard water for back-wash purposes.

Piping and Wiring

Inasmuch as each individual group of assembled equipment carried with it all the pre-assembled, interconnecting piping and wiring between motors and starters, there remained only the necessity of providing the necessary piping and wiring to interconnect these assemblies. It was possible, therefore, within the limits of shipping clearances, to crate all the necessary piping, valves, fittings, pipe insulation, conduit, and wiring in one case of about 6 ft in cross section and 20 ft long.

All piping of 2 in. nominal diameter and over was entirely prefabricated and shop assembled in the largest pieces consistent with shipping clearances. The smaller sizes of piping were shipped in random lengths, with the necessary loose valves, fittings, and the

POWELL VALVES

by prescription

"Doctor-book" treatment is of dangerously doubtful value when an undiagnosed condition exists, or is suspected to exist! The experienced collaboration of physician and pharmacist is not only indicated but required.

Specific conditions to be met in the installation and functioning of valves likewise demand specific specialization . . . the working together understandably of engineering and manufacturing experience to produce the valve to meet these conditions.

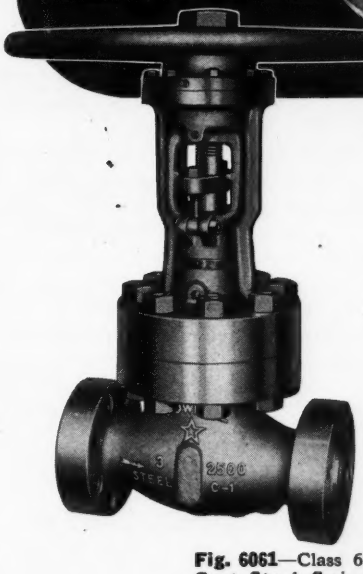
The successful experience of nearly a century of POWELL Engineering and manufacture of valves—and valves only—is at your service . . . in consultation, in prescription, in supply. This clinical know-how, gained in thousands of "cases" is the professional asset we share with every POWELL Valve buyer.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

Fig. 25031 — Class 2500-pound Cast Steel Globe Valve. Has flanged ends, outside screw rising stem and bolted flanged yoke. Sizes 1" to 6", incl.



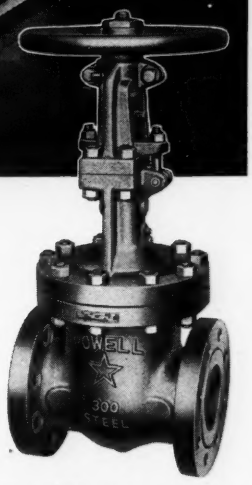
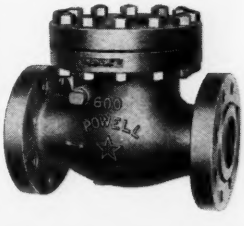


Fig. 3003—Class 300-pound Cast Steel Gate Valve, with flanged ends, outside screw rising stem, bolted flanged bonnet, two-piece yoke and taper wedge solid disc.

Fig. 6061—Class 600-pound Cast Steel Swing Check Valve. Has flanged ends and bolted flanged cap, held securely by an ample number of bolts. Renewable disc is hung on 5° angle and when wide open permits a full, straightway, unobstructed flow through valve body. Sizes 1¼" to 12".



POWELL VALVES

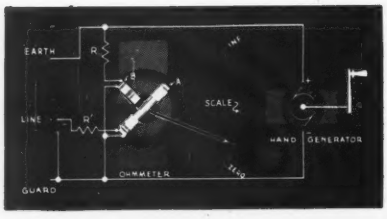
. . . THE "MEGGER"* INSULATION TESTER

The dependability of the "Megger" Instrument for measuring electrical insulation resistance is like the constancy of Ohm's Law, on which principle it actually operates. This "Megger" method for testing insulation resistance is simple and remarkably accurate. The principle is precisely the same as it was forty years ago and yet it meets today's needs perfectly.

You will find the same ruggedness and dependability in U.S.-made "Megger" instruments that the electrical industry has known for so long a time.

Let us send you full details on various types and ratings. Ask for Bulletin 1685-PE.

* *Trade Mark Reg. U. S. Pat. Off.*



PRINCIPLE OF OPERATION

In what we term a cross-coil true ohmmeter, two coils are mounted in fixed relation to each other on the same pivot-and-jewel moving system in the field of a permanent magnet. "Current" flows in coil A and "potential" in coil B, and they are connected so that their respective torques oppose each other. Since there are no control springs, the opposing coils give a true ratio of E/I, and ohms (or megohms) are indicated directly by a pointer over a scale. The readings are independent of the voltage of the hand-driven d-c generator, because any change in the voltage affects both coils in the same proportion.

JAMES G. BIDDLE CO. 1211 ARCH ST. PHILA. 7, PA.

like, all marked for easy identification for fabrication and assembly in the field. High pressure piping systems were of welded construction. For the most part, the low pressure steam and water systems were of screwed construction.

The main generator leads to the switchgear were shipped in one length, to be cut in the field. The smaller wiring for auxiliary power circuits was shipped in coils of sufficient lengths to be cut in the field, as required. The conduit (electric metallic tubing in this case) was furnished in trade lengths. Necessary connectors, couplings, fittings, ground rods with connectors, and bare ground wire were included. Miscellaneous cable supports, bushings, etc., were furnished for field installation. All items were appropriately marked for ready assembly.

Fuel Handling

Given a good quality of coal, it would not have been necessary to furnish any facilities for fuel and ash handling beyond wheelbarrows and shovels. The fact, however, that exceptionally low grade coal (5900 Btu per lb) and peat (5000 Btu per lb), as well as wood (5000 Btu per lb), is involved, indicated that large volumes of fuel will have to be moved. Consequently, conveying equipment of the tramway-bucket type was furnished, together with a portable conveyor for unloading coal to a raw coal bin. With each of these plants a coal and peat crusher was provided, as it is not always possible to obtain prepared sizes of coal and peat at the various plant sites. The portable conveyor also will be used to deliver coal from the crusher discharge to the prepared peat and prepared coal bin. Cord wood will be moved into position for hand firing by substituting slings for the bucket of the tramway system. All coal bins are temporary wooden structures.

This package type power plant has been so designed as to permit its complete assembly, from the arrival of the equipment on flat cars to actual power generation, within a period of 36 hr. This time element is of extreme importance, since in many instances these plants will move with armies. Each plant was furnished with a complete manual, including instructions and drawings, for construction, operation, and maintenance. Each individual item of the assembly was appropriately marked with an identification which relates to the manual.

Future Applications

Whether the basic package plant idea may be refined and modified to the point where the package type power plant could, in times of peace and more leisurely economy, compete with plants of the stationary type, each one of which is designed to meet specific conditions, is a question for examination and debate at a later date.

The electrical generating capacities of these plants can be increased readily to 1250 kw within the limitations of the present steam generator unit, water treating units, and their acces-

Faircoseal Valves

Pipe and Valve Made One-Piece by Brazing

Fairbanks Faircoseal Bronze Valves contain preinserted rings of Sil-Fos silver brazing alloy in the port openings. By applying an oxy-acetylene flame the valve and non-ferrous metallic pipe can be easily brazed together, forming Silbraz joints.

These permanent, leak-proof Silbraz joints will withstand more tension, compression, torsion, vibration and corrosion than the pipe. They will not pull apart at any temperature that can be safely applied to the valve or pipe — yet they can be taken apart, if desired, by reapplying heat.

Faircoseal Valves are made in various types for steam working pressures from 125-300 lbs. Write for Bulletin No. 33.

THE FAIRBANKS COMPANY

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BOSTON, MASS. PITTSBURGH, PA.

Here's how
REX-TUBE...
licks maintenance problems

Chicago Metal Hose Corporation's "Rex-Tube" is used on many types of original equipment. In addition, this standard flexible metal hose is used for maintenance requirements throughout industry in general, frequently replacing more cumbersome and troublesome piping hook-ups.

The application *always* determines the type of flexible metal hose that should be used. Chicago Metal Hose Corporation manufactures the most diversified line of flexible metal hose products. Therefore, C.M.H. engineering recommendations are complete and unbiased.

The complete line of Chicago Metal Hose Corporation fittings makes installations easier and faster. If you are concerned with the replacement of flexible metal hose, write for complete information.

Flexible Metal Hose for Every Industrial Use

CMH
CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

sories and appurtenances. Much of the initial development for such increased capacities already has been accomplished.

It is entirely within the realm of imagination that this idea of package type power plants may be further developed along the lines of a mail order business.

Treating Process Water for Wright Aeronautical

(*Continued from page 77*)

10. Backwash water leaving the filters enters the backwash water storage basin for return to the softening basin. The level in the backwash storage tank is indicated on each control table (Fig. 6) at the filters and equipped with an alarm so that the operator is aware of the amount of storage space still available in this tank at any point of the backwash and to prevent overflow.

11. Chemical and bacteriological tests are made daily at desired intervals and a complete record is kept on all phases of operation. With the assistance of these controls, a consistently satisfactory water is delivered for plant usage, well within the desired limits to obtain objectives as originally specified.

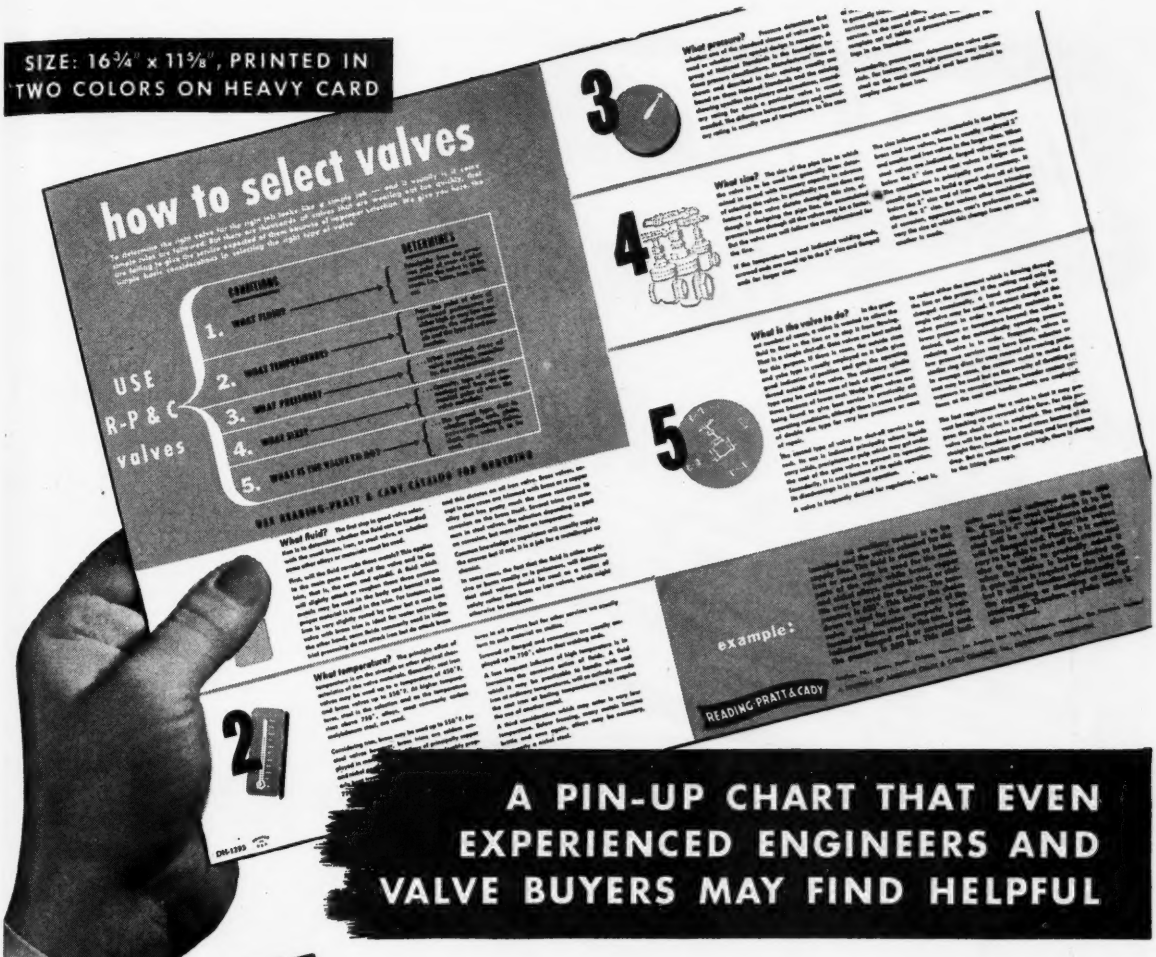
The architecture, structural and building design is by Albert Kahn. W. H. & L. D. Betz were the consultants on the functional design of the water softening plant, working in close collaboration with the Wright Aeronautical Corp. engineers. This industrial water treatment plant is one of the largest and most modern industrial water treatment plants in existence.

High Interrupting Capacity Fuses

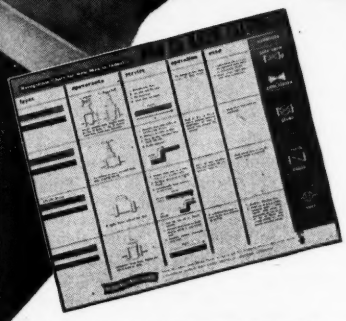
(*Continued from page 79*)

order to properly coordinate the fuse, thermal relays, and starter characteristics with those of the motor. Current limiting fuses cannot be applied to any and all existing motor starters and adequate protection for the starter obtained. It is necessary that the starter have a short time current rating equal to the maximum fault current permitted by the fuse. As an example of the problems involved in the selection of the proper current limiting fuse rating, consider the two 300 hp motors on feeder No. 1. The full load currents are the same. The one is a low speed synchronous motor which draws a starting inrush current of 290 amp, thus requiring a fuse rated 125 amp continuous. The second motor is a high speed induction motor which has an inrush current of 590 amp, requiring a 200-amp fuse. But since the 200-amp fuse will permit approximately 50 per cent more current to flow into the fault for the same available short circuit current, the thermal relays operating the oil immersed contactor must have considerably more thermal capacity than the relays on the other motor although of the same rating. The proper coordination of current limiting fuses and contactors cannot be stressed

SIZE: 16¾" x 11⅝", PRINTED IN TWO COLORS ON HEAVY CARD



A PIN-UP CHART THAT EVEN EXPERIENCED ENGINEERS AND VALVE BUYERS MAY FIND HELPFUL



HOW TO KNOW VALVES

A companion chart to **"how to select valves."** Tells how to identify quickly gates, globes, checks and cocks. Shows their distinct differences in appearance, the services to which each is suited, how each operates and where each should be used. Address Reading, Pa. office for a copy.

This easily read chart 16¾" x 11⅝" covers the 5 major considerations that determine the selection of valves.

1. **The fluid, from a corrosive standpoint, determines whether the valve should be made of brass, iron, steel, etc.**
2. **Temperatures, from the point of view of continued performance, determine valve materials and end connections.**
3. **Pressure determines the standard class to employ; and, secondarily, valve materials.**
4. **Size determines valve capacity, end connections and valve materials.**
5. **What the valve is to do determines whether to use cock, gate, globe, check, pressure-reducing valve, etc.**

This data is compressed into the READING-PRATT & CADY chart **"how to select valves."** Experienced men will find it an excellent prompter when they are discussing valves, and new men in industry will find its information an invaluable guide. Copy sent gladly. Address our offices in Reading, Pennsylvania.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisc.

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT

Seamless steel tubes are the intestines of the ship, the power plant, the oil refinery, the locomotive, and the chemical plant...delivering an ever-flowing flood of power to America's mighty production efforts.

Seamless steel tube "know-how" is vitally necessary to keep those lines going steadily. Cold drawn seamless steel PTP tubing achieves accuracy to size and uniformity of gauge through exacting control and thorough inspection at every step in manufacture. Where cost is a factor, and seamless steel tubing required, PTP tubing offers an economical and satisfactory solution to the problem.

★ Official United States Navy photograph. 440 series destroyer; a component part of the great American Fleet, largest in the history of the world.

PIPE & TUBE PRODUCTS
INCORPORATED
Manufacturers of Cold Drawn Seamless Steel Tubing
JERSEY CITY, N. J. • WORKS: READING, PA.

too much. Such a coordinated combination provides the ideal and most inexpensive high voltage motor starter available.

Conclusions

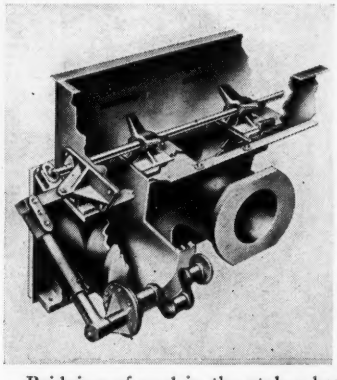
In conclusion it should be emphasized that high interrupting capacity fuses provide a highly reliable yet inexpensive short circuit protective device and that such fuses properly applied from an engineering viewpoint will greatly enhance system operations and stability in addition to decreasing damage in the faulted equipment protected by the fuse.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Coal Feed Agitator

UNIFORM coal feeding in multiple retort underfeed stokers is now assured by a new agitating device incorporated in the latest type Taylor Stoker, manufactured by American Engineering Co., Philadelphia 25, Pa.

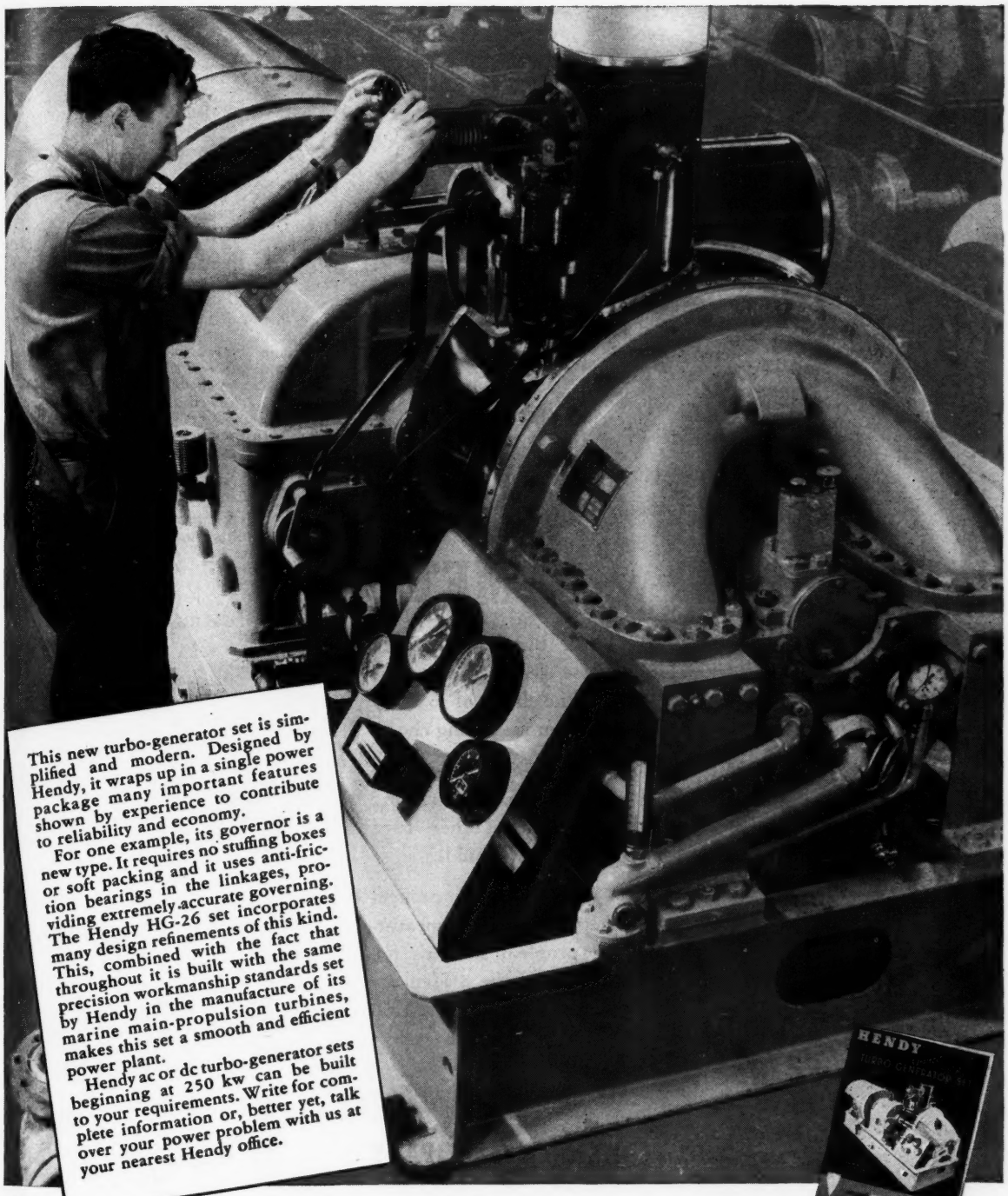


Bridging of coal in the stoker hopper, especially in the winter when the coal supply is wet or partially frozen, is eliminated by the agitator's reciprocating motion across the stoker width between retorts. This also prevents bridging across the hopper lengthwise of the stoker, by breaking the support of the arch formed when the coal flow is interrupted.

Power for the agitator is provided by the stoker's all-spur gear planetary transmission. A shearing pin provides protection against tramp iron or other obstructions in the coal. Oil-impregnated bushings need no lubrication.

Self-Draining Compressed Air Separator

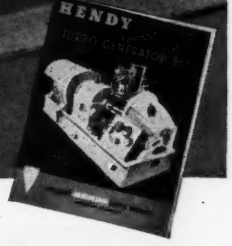
A SELF-DRAINING compressed air separator, which eliminates the need for external traps or the uncertainties of manual draining, has been developed by the Johnson Corp. of Three Rivers, Mich. Known as the Johnson Type SA Separator, it has a complete trap mechanism built right in, which releases from the separator, automatically, all the water, oil and other moisture that has been removed from the compressed air.



This new turbo-generator set is simplified and modern. Designed by Hendy, it wraps up in a single power package many important features shown by experience to contribute to reliability and economy.

For one example, its governor is a new type. It requires no stuffing boxes or soft packing and it uses anti-friction bearings in the linkages, providing extremely accurate governing. The Hendy HG-26 set incorporates many design refinements of this kind. This, combined with the fact that throughout it is built with the same precision workmanship standards set by Hendy in the manufacture of its marine main-propulsion turbines, makes this set a smooth and efficient power plant.

Hendy ac or dc turbo-generator sets beginning at 250 kw can be built to your requirements. Write for complete information or, better yet, talk over your power problem with us at your nearest Hendy office.



JOSHUA **HENDY** IRON WORKS

ESTABLISHED 1856

SUNNYVALE, CALIFORNIA

For complete data write for new catalog on Hendy Type HG-26 Auxiliary Turbo-Generator sets.

46-V

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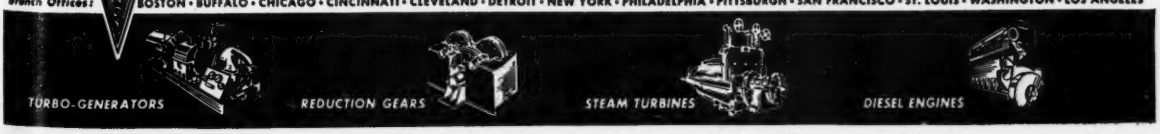
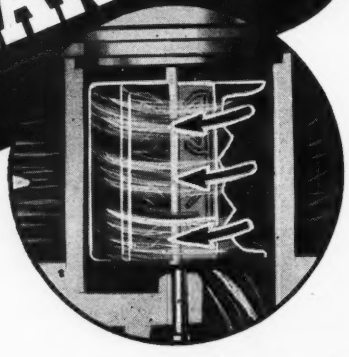


NO CLOSE CLEARANCES



in the

HENSZEY *Feed Water* METER

The abrasive action of hot, dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances for their accuracy. That's why the Henszey meter is the choice of so many Power Plant Engineers for the Boiler Blowdown measuring chore.

Henszey meters stay accurate—stay on the job—accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-running Chemicals and other "hard to measure" liquids.

Sizes from 10 g.p.m. to 1200 g.p.m. cold water steady flow rating. Pipe connection ¾" to 6"—special sizes to order.

If you have a particularly tough liquid measuring problem send us the details—maybe a Henszey Feed Water Meter can do the job where other meters have failed.

HENSZEY COMPANY
Dept. C-8 Watertown, Wis.

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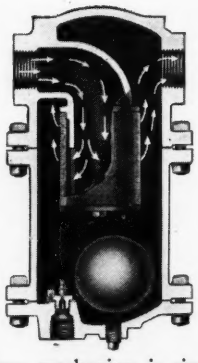
FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves

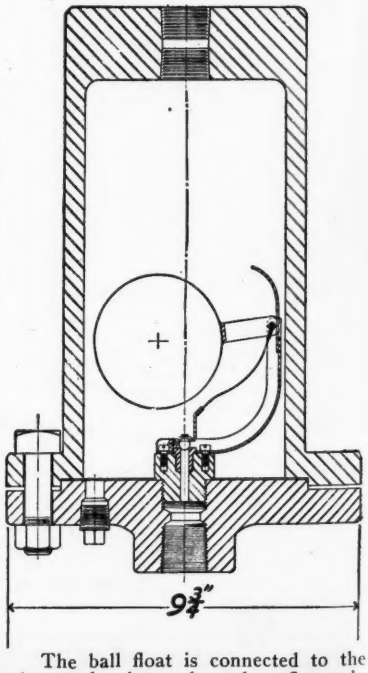


The trap mechanism is simple and compact, with spherical float and chrome steel valve and valve seat. It is mounted on the bottom plate of the separator body, and can be quickly and easily removed for inspection or cleaning. All the moisture that has been removed from the compressed air drops to the bottom of the separator, and when the level of the accumulated liquid is sufficient to raise the float, the valve opens and the liquid flows out the drain.

The Johnson Type SA Compressed Air Separator is available with capacities of 80 or 160 cu ft of free air per minute at 90 lb pressure.

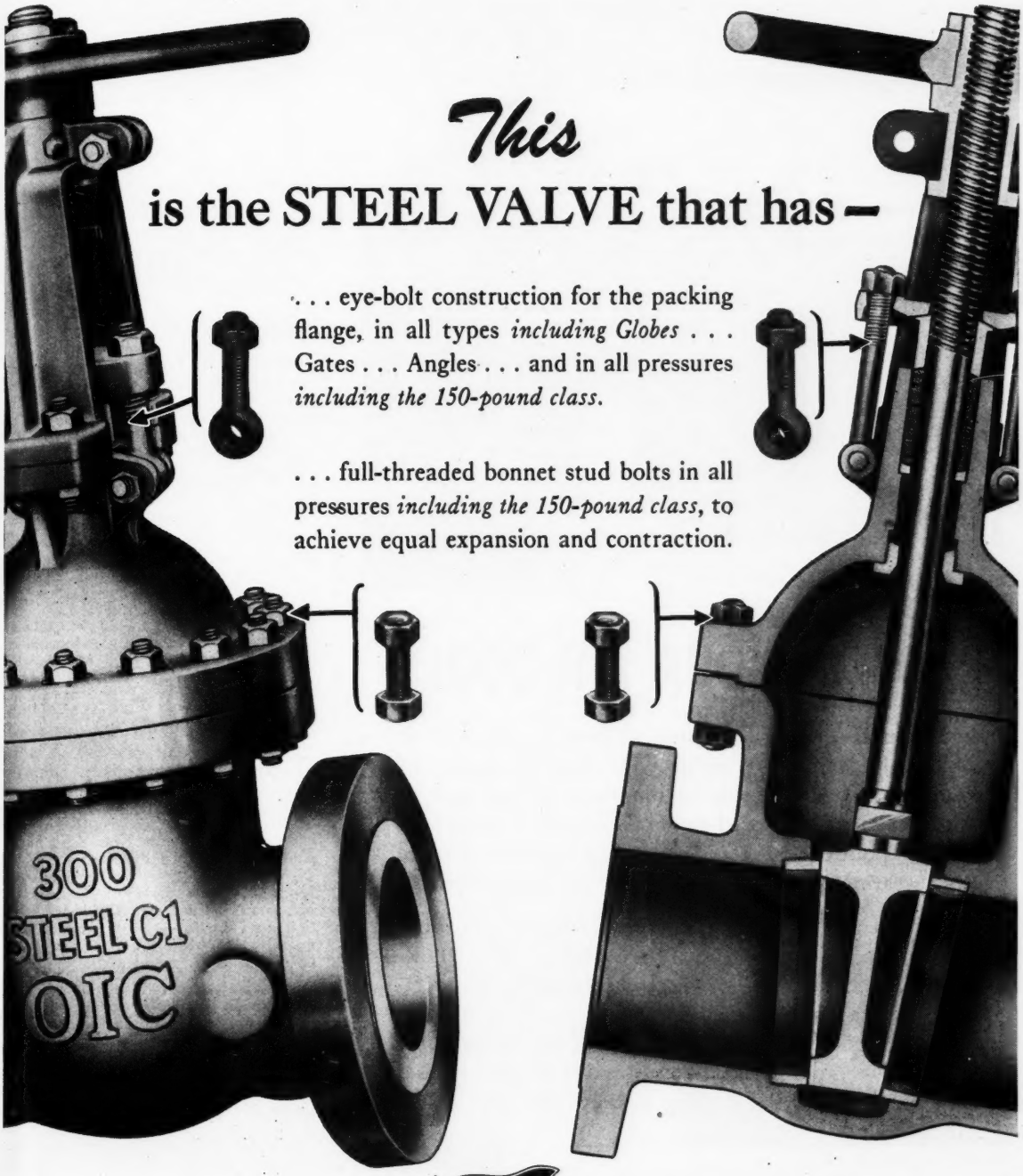
Compressed Air Trap

ANNOUNCEMENT has been made by the Armstrong Machine Works, Three Rivers, Mich., of the development of a new high pressure "Snap-Action" air trap, No. 71-315, for draining water from compressed air systems under pressures up to 1000 psi. The body and cap of this trap are forged steel and the ball float is designed to withstand hydrostatic pressures of 1500 lb.



The ball float is connected to the short valve lever through a flat strip of stainless steel spring. As the incoming water raises the ball float, the initially concave bent spring is so at-

This
is the STEEL VALVE that has –



. . . eye-bolt construction for the packing flange, in all types *including Globes* . . . Gates . . . Angles . . . and in all pressures *including the 150-pound class.*

. . . full-threaded bonnet stud bolts in all pressures *including the 150-pound class,* to achieve equal expansion and contraction.

OIC Cast Steel Valves . . . Gates . . . Globes . . . Angles . . . Checks . . . are available in the 150 and 300-pound pressure classes, with screwed, flanged or butt welding joints.

ARMY E NAVY

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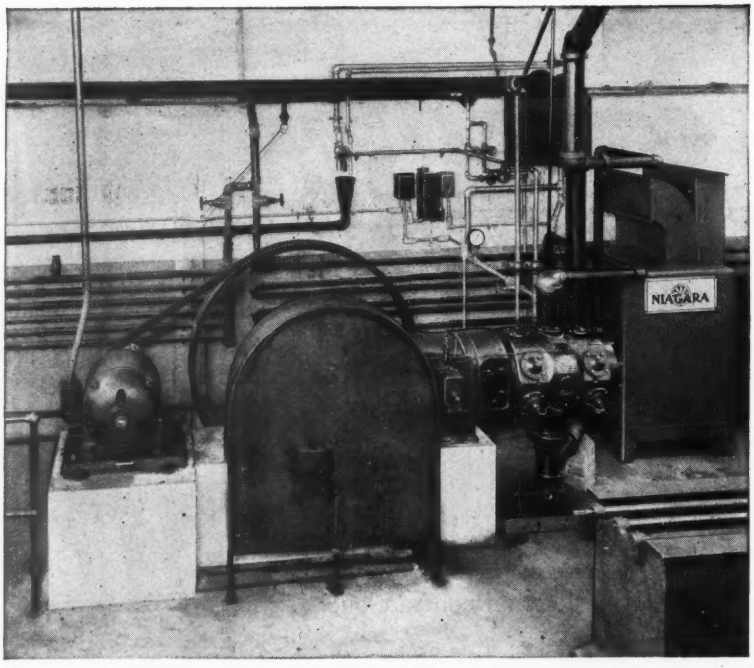
There is an OIC Distributor near you who is ready to demonstrate to you the many superior features of OIC Cast Steel Valves. Call him or write to us for full details.

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883



PROTECT YOUR AIR TOOLS

● The moisture that is condensed from compressed air is the chief source of trouble with air lines, tools and equipment. It may freeze in the lines; it may rust or damage products exposed to the air stream; it washes the lubricants out of your tools and causes rusting and more rapid wearing out of parts, especially in rotary tools.

To protect this equipment, take the excess moisture out of compressed air by using the NIAGARA *AERO* AFTER-COOLER. It produces lower compressed air temperatures and the resulting air contains only one-half to three-fourths as much moisture as air cooled by conventional methods. Because it is an evaporative cooler, it uses atmospheric air as the cooling medium and pays for itself by saving water costs.

For Complete Information, write to

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"25 Years of Service in Air Engineering"

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NIAGARA

INDUSTRIAL COOLING • HEATING • DRYING
HUMIDIFYING • AIR ENGINEERING EQUIPMENT

tached to the float that as the spring moves past dead-center it snaps the float up and the valve is thrown wide open. Drainage is immediate. When the water level drops, the cycle is reversed and the valve snaps tight in closing. No throttling effect occurs and it is claimed that wire drawing is eliminated. It is also claimed that the trap will handle all ordinary oil and dirt without clogging.

OBITUARIES

Edmund H. Lunken

EDMUND H. LUNKEN, Chairman of the Board of The Lunkenheimer Co., Cincinnati, Ohio, died Wednesday, July 19, at his summer home in Michigan, as the result of cerebral hemorrhage. Mr. Lunken, who was 83 years old, had been active and in good health until last winter, when he suffered an attack of influenza.

The son of Frederick Lunkenheimer, founder of The Lunkenheimer Co., he was born in Cincinnati and educated in the Cincinnati schools. At the age of 16 he entered his father's business, which had been established in 1862. Upon the death of his father in 1889, he assumed leadership of the company and remained its senior officer until his death. In 1892, he legally changed his surname to Lunken, but did not change the name of the company.

C. H. M. Jones

C. H. M. JONES, Assistant to President of Todd Shipyards Corp., and widely known veteran New York newspaperman, died unexpectedly in his sleep on May 25 at his residence in Montvale, New Jersey. He was 58. Mr. Jones joined the Todd organization on March 3, 1919, and carried on with his work up to a few hours before he was stricken.

At his death, Mr. Jones as assistant to John D. Reilly, President of Todd Shipyards Corp., administered policies of the corporation dealing with the vast personnel of the world-wide ship repairing and shipbuilding organization as well as public relations. It was under his personal direction that the wartime activities of the Todd Shipyards throughout the country and abroad were coordinated and widely publicized. He served in a similar capacity during World War I with William H. Todd, founder of the corporation.

Richard O. Muller

RICHARD O. MULLER, former chief engineer of The Terry Steam Turbine Co., passed away on June 4, 1944. He had been in poor health for some time and had retired from active work several months ago.

Mr. Muller was associated with the steam turbine industry practically all his life. He started at an early age with the Parsons Co. in England. He came to this country and was em-

Hardness

...WHAT IT MEANS IN A METAL
WHAT IT MEANS TO A METAL USER

Next to strength, the property usually most sought in a metal is *hardness.*

A dictionary calls a material hard when it is "not easily penetrated, cut, or separated into parts, not easily yielding to pressure."

Others call it "the ability to resist plastic deformation," and "resistance to indentation or penetration."

In short, an exact definition of hardness seems to have stumped even Webster.

What hardness *is,* however, is not so important as what it *does.*

Generally, the harder a metal, the greater its resistance to frictional wear, the better it fights the blasting action of grit and other abrasive substances, and the longer it holds off the erosive effect of steam or water.

Though hardness must share credit with toughness and ductility for resisting most forms of wear, hardness usually gets the nod as the most important of the three.

Since no one method of hardness testing is applicable to all shapes of materials, several types of testing machines have been developed. Of these, the Brinell, Rockwell and Vickers machines are basically similar, as all measure penetration of the metal under test... by ball, cone or pyramidal indenter. The Scleroscope measures hardness by the "bounce" of a diamond-tipped hammer.

As a group, the INCO Nickel Alloys are in the upper hardness range, varying from medium to very hard, as shown in the chart at the bottom of this page.

Note the exceptional hardness of "K" Monel, "Z" Nickel, and "S" Monel.

"K" Monel can be heat-treated after finishing, for applications that require a corrosion-resisting material with extremely high strength and hardness. "S" Monel is an extremely hard and strong cast alloy for non-galling valve trim, pump liners, etc. It retains high hardness at red heat. "Z" Nickel, one of the hardest non-ferrous alloys obtainable, can be heat-treated after forming to develop 2½ to 4 times the strength of structural steel.

The practical advantages of hardness are illustrated by the record of the Monel rods in the pump shown above. The pump has been at work since 1918, handling gritty waters from ash quenching and corrosive waters from coal drainage. The Monel rods have given trouble-free service during the whole quarter-century.

A second pump was installed ten years after the first. Its rods were made of bronze. Three sets failed in less than 10 years. Monel rods were then installed. The second pump, like the first, has had no rod trouble since that time ... the *hardness* of Monel along with its greater corrosion resistance, rigidity and toughness has made the difference.

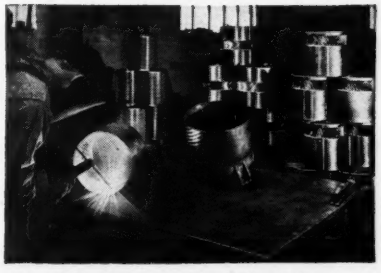
Another application that shows how Monel's hardness cuts down trouble is the use of Monel steam separators for cargo vessels.

SUMP PUMP *with long-wearing hard Monel rods at work in New York Public Library for over 25 years.*

Steam coming direct from a boiler carries moisture and solid particles. This foreign matter would blow through the lines and erode the vital parts of equipment if the separator did not remove it.

Formerly, the Dri-Steam Products Co. used thick castings of a softer corrosion-resistant metal as inner cylinders for the separators. The cylinders often failed from erosion after only three months' service.

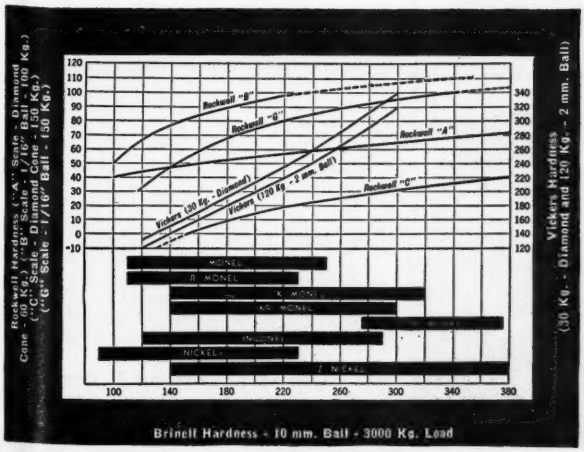
An improved type of separator was then fabricated from Monel sheet. Half the weight, and a third less expensive than the old type, the Monel separators



STEAM SEPARATORS *of hard Monel sheet, cut cost 30%, weight 50% ... and give over 8 times the service of former type. Made by Dri-Steam Products Co., New York, N. Y.*

have been in use for over two years. Not one has failed... Monel's added hardness has again produced longer, trouble-free life.

For further light on hardness... and on other mechanical properties that determine a metal's suitability for specific applications... write for a copy of the 26-page bulletin, "The Technical Editor Speaks..." A copy is yours for the asking.


Rockwell Hardness ("A" Scale - Diamond Cone - 60 Kg. - "B" Scale - 1/16" Ball - 100 Kg. - "C" Scale - Diamond Cone - 150 Kg.) ("G" Scale - 1/16" Ball - 150 Kg.)
Rockwell "B"
Rockwell "G"
Rockwell "A"
Rockwell "C"
Vickers (30 Kg. - Diamond)
Vickers (120 Kg. - 2 mm. Ball)
MONEL
R MONEL
K MONEL
S MONEL
NICKEL
Z NICKEL
Vickers Hardness (30 Kg. - Diamond and 120 Kg. - 2 mm. Ball)
Brinell Hardness - 10 mm. Ball - 3000 Kg. Load

HARDNESS OF INCO NICKEL ALLOYS. *The hardness range of each alloy is shown by the horizontal bars; the approximate relation between Brinell, Rockwell and Vickers hardness numbers is shown by the conversion chart.*

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N. Y.

R/M PACKINGS
Give Top Performance Under Pressure

Transmitting the push of a button into tons of pressure calls for tight packings all along the line. Hydraulic equipment, pumps and pipes for all kinds of fluids, boilers and engines call for tougher packings today than ever before. Under these abnormal conditions of forced production, R/M packings are helping to keep war-weary equipment steadily at it.

As we approach the end of the struggle, more and more R/M products will be diverted to meet normal industrial requirements. Once again you will find R/M has the economical answer to every packing and gasket problem.

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RAYBESTOS-MANHATTAN, INC.
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BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

ployed by the E. W. Bliss Co. of Brooklyn, N. Y., as a turbine engineer. At one time he did considerable consulting work in Washington, D. C. He joined The Terry Steam Turbine Co. in 1915 and was made chief engineer in 1926.

H. Edward Manville, Sr.

H. EDWARD MANVILLE, SR., former Chairman of the Board of Directors of Johns-Manville Corp., died June 27, 1944. Mr. Manville's death marked the passing of one of the pioneers of American industry who helped build the foundation of Johns-Manville. Born in Neenah, Wis., February 6, 1872, Mr. Manville was one of three sons of the late Charles B. Manville.

He is survived by the widow, Mrs. Estelle Romaine Manville; a daughter, Countess Estelle Bernadotte, now living in Sweden, and a son, H. Edward Manville, Jr., 1st Lieutenant now serving with the 848th Army Air Forces Specialized Depot, at Syracuse, N. Y.

MANUFACTURERS' PERSONALS

New officers of the Dampney Co. of America were elected recently at a Board of Directors' meeting following the death of William H. Laverack, president since 1931. The new officers of this company, manufacturers of Apexior protective coatings for metals, are as follows: Clarence J. Hunter, President and General Manager; J. W. Laverack, Vice-President and Treasurer; J. Dwight Bird, Vice-President in charge of Railroad and Mid-West Power Sales; William Richards, Vice-President in charge of Marine Sales.

Allis-Chalmers Mfg. Co. announces that B. H. McCoin will be stationed at the Atlanta office of the company as a field engineer. Mr. McCoin, who has been with Allis-Chalmers since April, 1944, has had many years of experience with electric power companies in Tennessee.

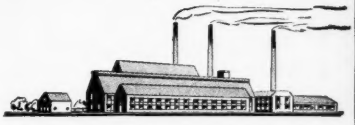
Stanley L. Burgess, 6432 Cass Avenue, Detroit, Mich., has just been appointed agent for Kieley & Mueller, Inc., North Bergen, N. J.

V. H. Hiermeier has been named industrial manager of the St. Louis office of the Brown Instrument Co., Philadelphia precision industrial instrument division of Minneapolis-Honeywell Regulator Co. Mr. Hiermeier, who succeeds I. K. Farley, has had 15 yr experience in the industrial instrument field. For the past few years he has been with the Brown Co. in its Chicago office.

Allen-Sherman-Hoff Co. has secured the services of William Hogan, Washington Rd., Augusta, Ga., formerly associated with Georgia Iron Works, as Hydroseal Pump Engineer to cover the Southeastern States. Similar services will be performed by J. C. Tyger, formerly with Pomona Pump Division of Joshua Hendy Iron Works, in the Mid-Western States with headquarters at 407 South Dearborn St., Chicago, Ill.

Glidden Engineering & Equipment Co., Dallas and Austin, Texas; E. Lloyd Widner, Knoxville, Tenn.; Babcock & Wilcox, Ltd., of Mexico City;

This APEXIOR coating on a plant boiler of a candy factory has been in service for 9 years without renewal. Operating pressure, 250 lbs.



HOW TO PREVENT WAR-STRAINED BOILERS FROM BOGGING DOWN

Under three-shift operation . . . a boiler may be called upon to evaporate three times as much as normally required. This means three years' work in one and because of severe overloads, probably more than three times as much wear.

In hundreds of industrial plants APEXIOR is one of the most important factors today in keeping boilers in service. It not only prevents serious corrosion — thus assuring uninterrupted operation and longer life — but also prevents tight bonding of water scale, extending the length of time between cleaning and making cleaning faster and easier.

Whether or not you have a high priority rating, uninterrupted boiler service justifies every possible safeguard and self-preservation justifies every protection of your boiler.

APEXIOR Prevents Corrosion for 2-3 Years

APEXIOR NUMBER 1 is brush-applied by hand or power coater. It fills in the pores and joints of all hot-wet surfaces, forming an impenetrable barrier against water. There is less adherent scale.

This tough, smooth coating is not affected by high temperatures or ratings, by chemical treatment of boiler water or by varying feedwater conditions. It does not retard heat transfer in operation.

APEXIOR Easily Renewed

The life of the application varies with the service and wear. It will last 2 or 3 years, often much longer.

Save Materials — Man Power

Apexiorize your boilers. Keep the metal young. Avoid damage and wasted man power that cannot be measured in dollars.

Write for Bulletin 1290 containing facts on a paint that fortifies metal against the ravages of war schedules.

Users like these have applied APEXIOR for years

Pontiac Motor Division

Portland General Electric Co.

Hercules Powder Co.

Gulf Shipbuilding Corp.

The Pullman Company

International Paper Co.

Socony Paint Products Co.

Sears, Roebuck & Co.

The Stanley Works

Combustion Engineering Co., Inc.

American Viscose Corp.

Curtiss Wright Corp.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

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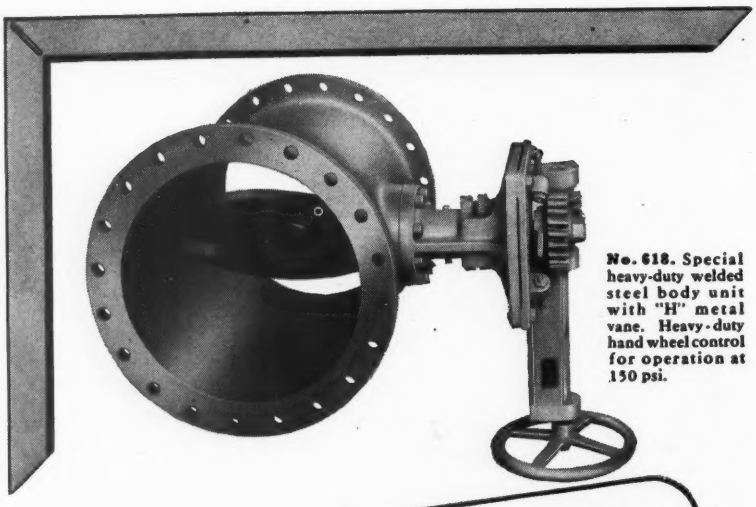
Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Honolulu, T. H., Marine Dept., 114 Liberty Street, New York City, N. Y.



No. 618. Special heavy-duty welded steel body unit with "H" metal vane. Heavy-duty hand wheel control for operation at 150 psi.

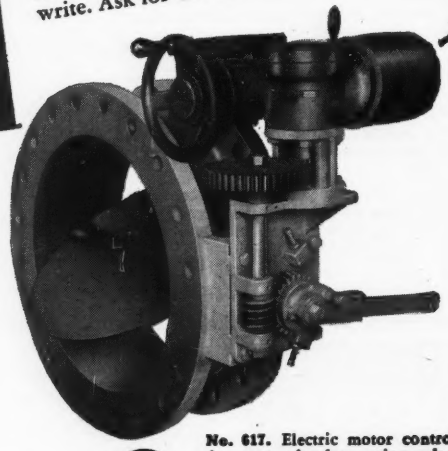
LOW HEAD LOSS SAVES POWER!

All R-S Butterfly Valves have streamlined vanes which offer minimum flow resistance. Flow conditions are similar to those produced in a venturi tube with high pressure recovery on the downstream side. Such a low head loss means a considerable saving in power particularly in large pumping operations.

Furthermore, there are no pockets, right-angle bends or reverse turns to collect sediment. When the vane approaches a closed position, the valve *tends to clean itself.*

Shut-off is accomplished by the beveled vane which wedges against the valve body. *Remember that four to six revolutions of the hand wheel completely open or close the valve vane.* Easily adapted to power operation.

If you are interested in a simplified and less costly method of control and shut-off, write. Ask for Catalog No. 14-B.



15 to 900 psi.
Control and shut-off of volume and pressure for air, gas, steam, liquids and semi-solids.

No. 617. Electric motor control for extremely slow acting valve. Hand wheel for manual operation on gear reduction drive. Extended lever for operation of sister valve in parallel line.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

and Sergio Ortiz Toro, Caracas, Venezuela have been appointed representatives of the L. J. Wing Mfg. Co., New York City, manufacturer of heating, ventilating and combustion equipment.

Elgin Softener Corp., Elgin, Ill., reports the appointment of B. M. Thompson, 8 E. 66th Street, New York City, as District Engineer in lower New York State and upper New Jersey; and Orra F. Hawn, 7 Academy Road, Albany, New York, as District Engineer in upper New York State.

MANUFACTURERS' NEWS

Dowell Incorporated announces the removal of its eastern district office from New York to 1400 Girard Trust Building, Philadelphia. Stanley C. Morian continues as district manager at the new district office with L. B. Wilson as development engineer and M. M. DeWitt as district engineer. Dowell will continue to maintain its New York office at 2020, 30 Rockefeller Plaza, under the management of W. E. Bisler, development engineer. The Upper Montclair, New Jersey, and Wilmington, Delaware, treating stations will continue to be managed by B. H. McDaniel and J. S. Grass.

On June 8 the Houdaille-Hershey Corp. bought all of the stock of the Honan-Crane Corp., manufacturer of oil purification equipment. Honan-Crane will be operated as a subsidiary of the Houdaille-Hershey Corp. and there has been no interruption in either manufacturing or sales activities. The corporation will continue to manufacture the same equipment and the change in corporate status will not affect any of the present policies.

John C. Traphagen, President of the Bank of New York, was elected to the Board of Directors of The Babcock & Wilcox Co. to succeed William Woodward, resigned after serving fifteen years. Mr. Traphagen is on the directorate of a number of corporations, including the International Nickel Co., the Baltimore & Ohio Railroad, the American Agricultural Chemical Co. and several insurance companies.

Fisher Governor Co., Marshalltown, Iowa, announces the appointment of The Sullivan-Mears Co. as its exclusive representative in the State of Kansas and in Western Missouri. Experienced sales and engineering service on Fisher automatic controllers is available at the new representative's offices located in the BMA Building, 215 Pershing Road, Kansas City, Mo.

The Westinghouse Electric International Co., which for more than 25 yr has operated in the international field as an exporter, has now entered the import field, according to an announcement by John W. White, President, who also made public the appointment of Hampton C. Marsh as manager of the new department.

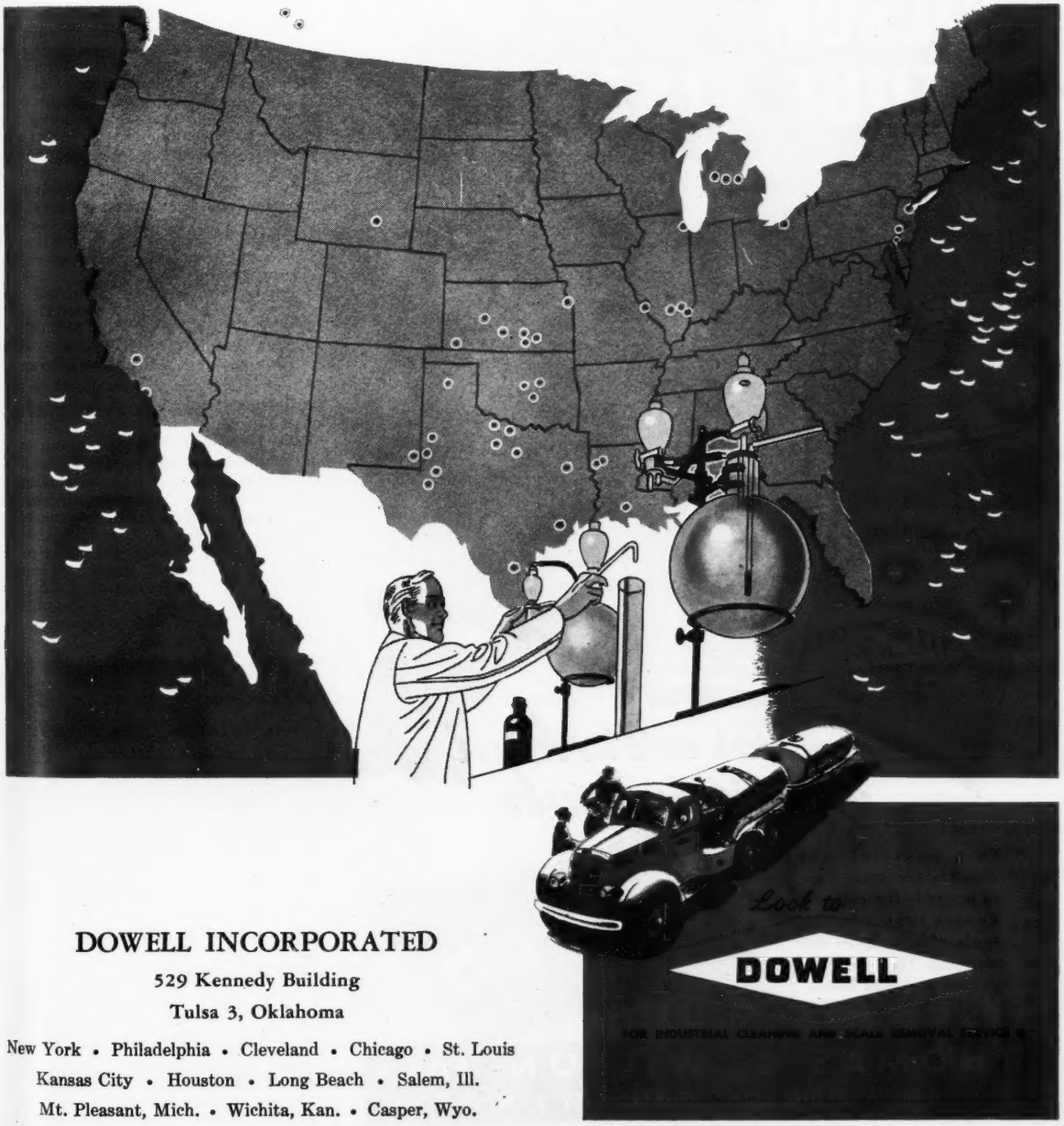
Mr. Marsh, who has been with the company's sales department for the past 15 yr, said that the new department has already started import negotiations in some of the foreign countries which are free to participate in trade under war conditions. Later the company plans to offer representation in the United States for firms abroad.

DOWELL INDUSTRIAL CHEMICAL CLEANING SERVICE

Chemical Research and Engineering

Wherever important industries are concentrated, Dowell Industrial Chemical Cleaning Service is readily available for quickly removing water and steam-deposited scale and sludge from all types of heat exchange equipment.

The research facilities of The Dow Chemical Company and the engineering staff of its wholly owned subsidiary, Dowell Incorporated, are continually broadening the field of application and introducing new techniques and materials. Engineering, plus chemical research, provides Dowell the means of furnishing to industry a modern method of restoring efficiency to heat transfer equipment.



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Mt. Pleasant, Mich. • Wichita, Kan. • Casper, Wyo.

NEWS FROM THE FIELD

Reorganization of Orrok & Myers

THE PASSING of Geo. A. Orrok, honorary member of the ASME, and senior member of this engineering organization for over 13 yr, has necessitated a reorganization of our facilities which has now been accomplished in the following manner:

The old name of Orrok & Myers will be continued with Myers, Fuller and Addington as successors, at the same address and with expanded engineering services.

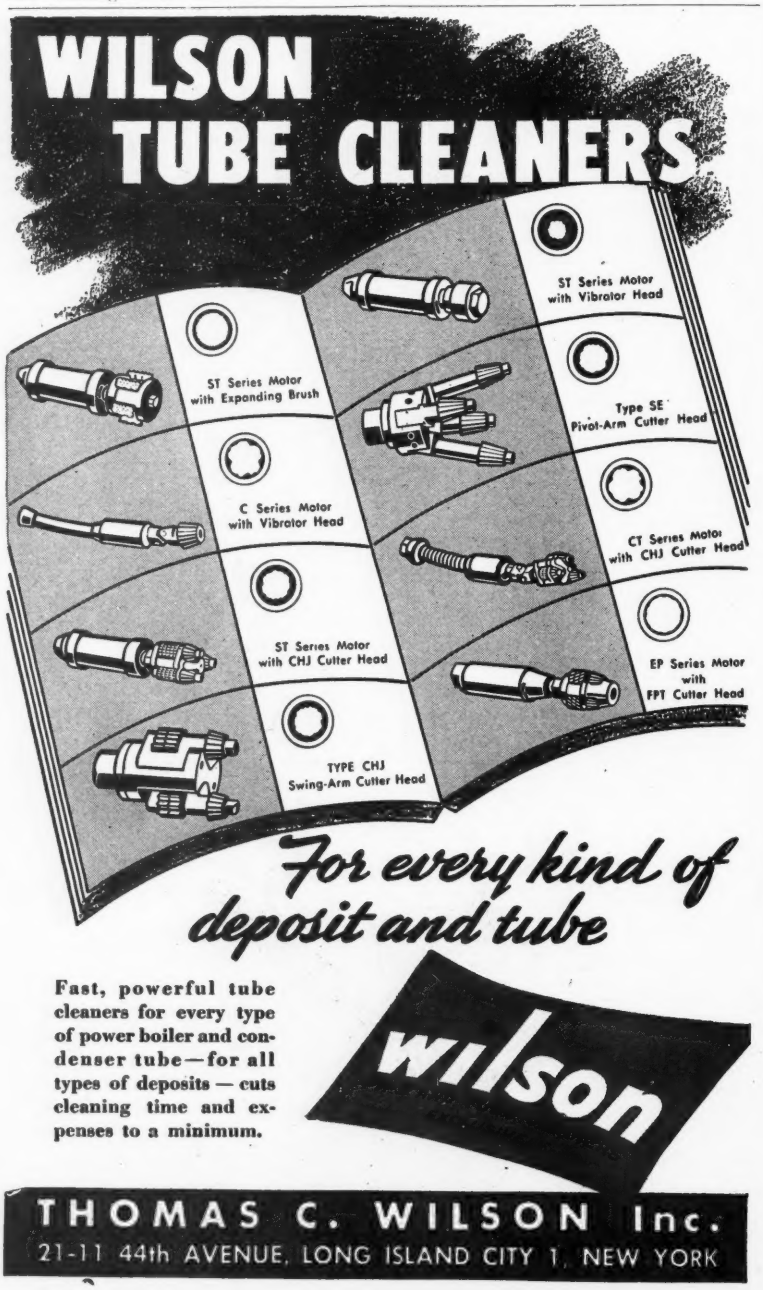
Charles A. Fuller, authority in heating, ventilating and air conditioning, formerly of the firm of Slocum & Fuller, and an associate of many years' standing, now occupies a portion of our office space for closer collaboration.

Herbert B. Addington, M. E., specialist in power plant design, who has been working with us on important projects for the past year and a half, has now become a member of our firm.

My partners in the firm of Binger-O'Connor-Orrok, Architect-Engineer, Walter D. Binger and Lester C. Hammond, under the name of Binger & Hammond, Engineers, have joined forces with us and we are now associated with them on active jobs involving factory building design and layout as well as power plant studies and modernization.

Our enlarged facilities have enabled us to undertake comprehensive problems in the field of industry, including studies and designs of both steam and power problems and heating and air conditioning, as well as buildings and structures of all types.

DAVID MOFFAT MYERS


WILSON
TUBE CLEANERS
ST Series Motor with Vibrator Head
ST Series Motor with Expanding Brush
Type SE Pivot-Arm Cutter Head
C Series Motor with Vibrator Head
CT Series Motor with CHJ Cutter Head
ST Series Motor with CHJ Cutter Head
EP Series Motor with FPT Cutter Head
TYPE CHJ Swing-Arm Cutter Head
For every kind of deposit and tube
Fast, powerful tube cleaners for every type of power boiler and condenser tube—for all types of deposits — cuts cleaning time and expenses to a minimum.
wilson
THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

Power Engineering Class Reopens For 25th Consecutive Year

THE POWER engineering class of the Public Adult Evening Schools of Philadelphia will reopen on September 25 for its 25th consecutive year. This class is an outgrowth of a class started some 30 yr ago by Clinton Shaw, a Philadelphia power engineer. At the present time, the class is under the direction of Dr. Albert A. Owen, Director of School Extension. Under his guidance the class has been giving instruction in power plant engineering to men ranging from 21 to 65 yr of age.

The aim of the course is to train men to become licensed operating and maintenance engineers. A certain amount of academic and commercial instruction is included. The course is a 3 yr course covering thermodynamics, mathematics, steam engines and boilers, valve setting, indicating engines, heating systems, calculation of boiler efficiency and upkeep of refrigerating systems.

Further information regarding the course may be obtained from Dr. Albert A. Owen, Director of School Extension, Public Adult Evening Schools of Philadelphia, 21st and Parkway, Philadelphia, Pa.

Midwest Stoker Association Elects Officers

AT THE ANNUAL meeting of the Midwest Stoker Association held recently in Chicago, the following officers, all of Chicago, were elected for the ensuing year: President, J. J. Hayes, Manager, Auburn Stoker Co.; vice-president, W. J. O'Neil, Branch Manager, Iron Fireman Manufacturing Co.; and secretary-treasurer, J. G. Beard, Assistant Manager, Stoker Division, Illinois Iron & Bolt Co.

Commonwealth Edison Co. Announce Retirement of Two Veteran Executives

TWO VETERAN EXECUTIVES of Commonwealth Edison Co.—H. B. Gear, vice-president in charge of operating and engineering, and A. G. deClercq, vice-president in charge of service and construction—retired from active service June 30. The board of directors have elected Alex D. Bailey and Curtis A. Lambert, respectively, both long in service, to succeed them.

Electrical Engineers Elect Officers

CHARLES A. POWEL, Manager, Headquarters Engineering Departments, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was elected president of the American Institute of Electrical Engineers for the year beginning August 1, 1944, as announced at the annual meeting of the AIEE

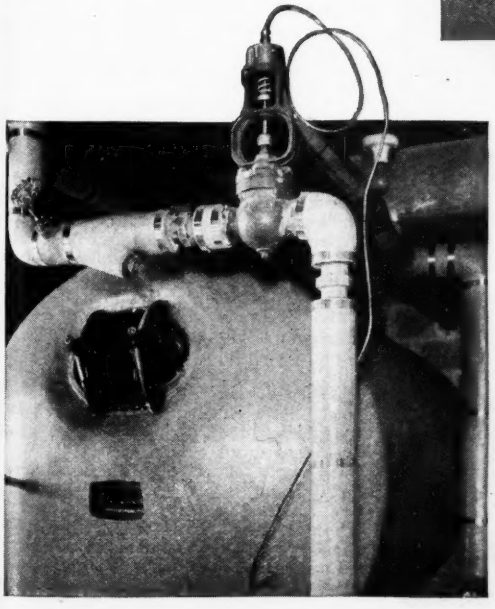
GUARDING INDUSTRIAL PROCESSES AGAINST TEMPERATURE VARIATION

FOR EVERY standard industrial use, for steam, hot and cold water or gas, wherever constant, uniform temperature is required, McAlear offers a temperature control valve engineered to maintain any desired temperature within a 40° range.

In ranges of 40° *each*—from 75° to 260° Fahrenheit—in sizes from ½ to 8 inches—these valves are available in body, trim and working part materials suited to the conditions and pressures encountered in each service.

Like all of McAlear's more than 500 standard controls—for regulating pressure, flow, liquid level and temperature—each is a precision instrument engineered for one specific application—in one set of operating conditions.

HOW TO APPROACH A CONTROL PROBLEM
Call on McAlear engineers. Draw on their fund of experience . . . on their readiness and willingness to help you develop special controls when *unusual* conditions require them. For informative bulletins and catalog, write McAlear Manufacturing Company, 1915 S. Western Avenue, Chicago 8. *Affiliated with: Hanlon-Waters Company, Tulsa; Climax Engineering Co., Clinton, Ia.*



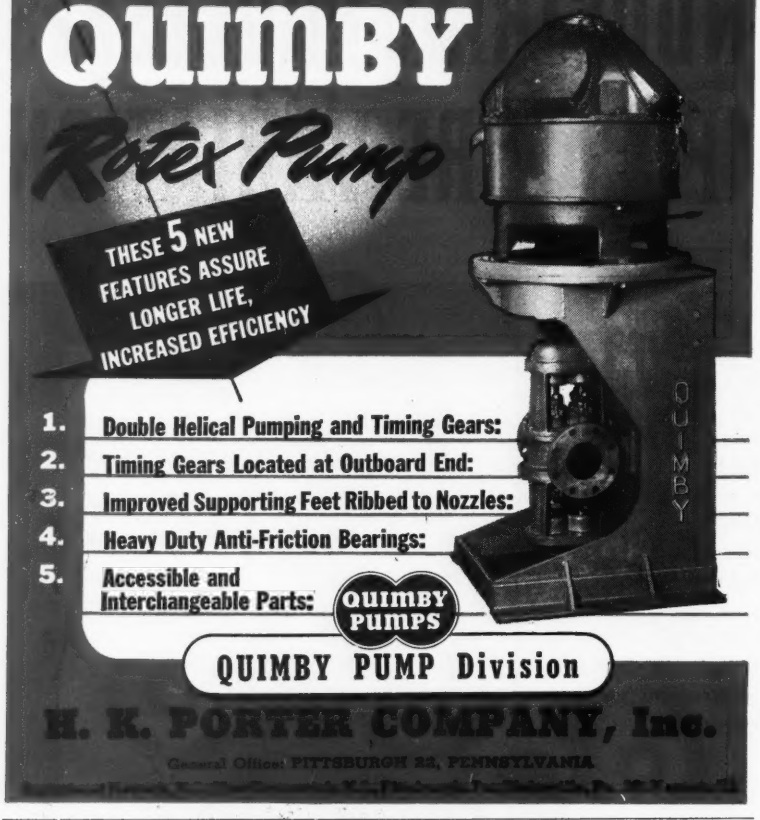
McALEAR No. 3100 TEMPERATURE CONTROL VALVE for steam, water and gas. Readily adjustable to any temperature within ranges of 40° each, from 75° to 260° Fahrenheit, sizes ½ to 4 inches. Used throughout process industries and in power plants. Bronze bulb and brass fittings standard—other metal combinations for special uses.

H-W McALEAR controls
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
for STEAM, WATER, AIR, OIL-GAS
WELDED TANKS
BOLTED TANKS
SEPARATORS

HANLON-WATERS TYPE 850 LEVEL CONTROLLER

This controller, first introduced 5 years ago, is still LEADER in the control of liquids of any gravity, temperature or working pressure. Applications: Control of liquid level. To actuate remote recording gauges. Duo-gravity control for wide range applications.

QUIMBY
Rotex Pump
THESE 5 NEW FEATURES ASSURE LONGER LIFE, INCREASED EFFICIENCY
1. Double Helical Pumping and Timing Gears:
2. Timing Gears Located at Outboard End:
3. Improved Supporting Feet Ribbed to Nozzles:
4. Heavy Duty Anti-Friction Bearings:
5. Accessible and Interchangeable Parts:
QUIMBY PUMPS
QUIMBY PUMP Division
H. K. PORTER COMPANY, Inc.
General Offices: PITTSBURGH 22, PENNSYLVANIA



CORROSION
Causes Expensive Replacements
Here is a cross section of a severely corroded water cooled connecting rod of a large gas engine. This corrosion can be controlled with our Chrom Glucosates.
This is but one of the many subaqueous corrosion problems that are solved by Haering and Company daily.
Let a Haering field engineer survey your corrosion problems and submit recommendations without any obligation on your part.
Write for "Scale and Corrosion Control in Aqueous Systems."
We Read Water
D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive, Chicago 6, Illinois

held in St. Louis, Mo., during the summer technical meeting of the Institute. The other officers elected were: Vice-Presidents R. T. Henry, Buffalo, N. Y.; J. F. Fairman, New York, N. Y.; M. S. Coover, Ames, Iowa; R. W. Warner, Austin, Texas; C. B. Carpenter, Portland, Ore.—Directors P. L. Alger, Schenectady, N. Y.; M. J. McHenry, Toronto, Canada; D. A. Quarles, New York, N. Y.—National Treasurer W. I. Slichter, New York, N. Y. (reelected).

Mr. Powel was born 60 years ago in Rouen, France, the son of Welsh parents, and was educated in London, England, and in Switzerland. In 1905 he joined Brown Boveri & Co. in Baden, Switzerland. He remained with Brown Boveri until 1915, spending the last four years as resident engineer in Kobe, Japan. During World War I he joined the civil branch of the British Ordnance Department and in 1916 came to the United States as an inspector with the British War Mission. He joined the General Engineering Department of Westinghouse at the East Pittsburgh, Pa., plant, specializing on power system engineering problems in 1919. Mr. Powel served as a director of the Institute from 1936 to 1940 and was vice-president for the term 1942-43. He has also served as chairman and member of many of the Institute's committees.

Fuel Efficiency Program

TWENTY-SIX new additional area coordinators have been appointed in 19 states in the National Fuel Efficiency program being conducted by the Bureau of Mines, and commercial and industrial consumers are urged to take an active part in the nationwide campaign to stretch the available supplies of coal, gas, petroleum, and other fuels.

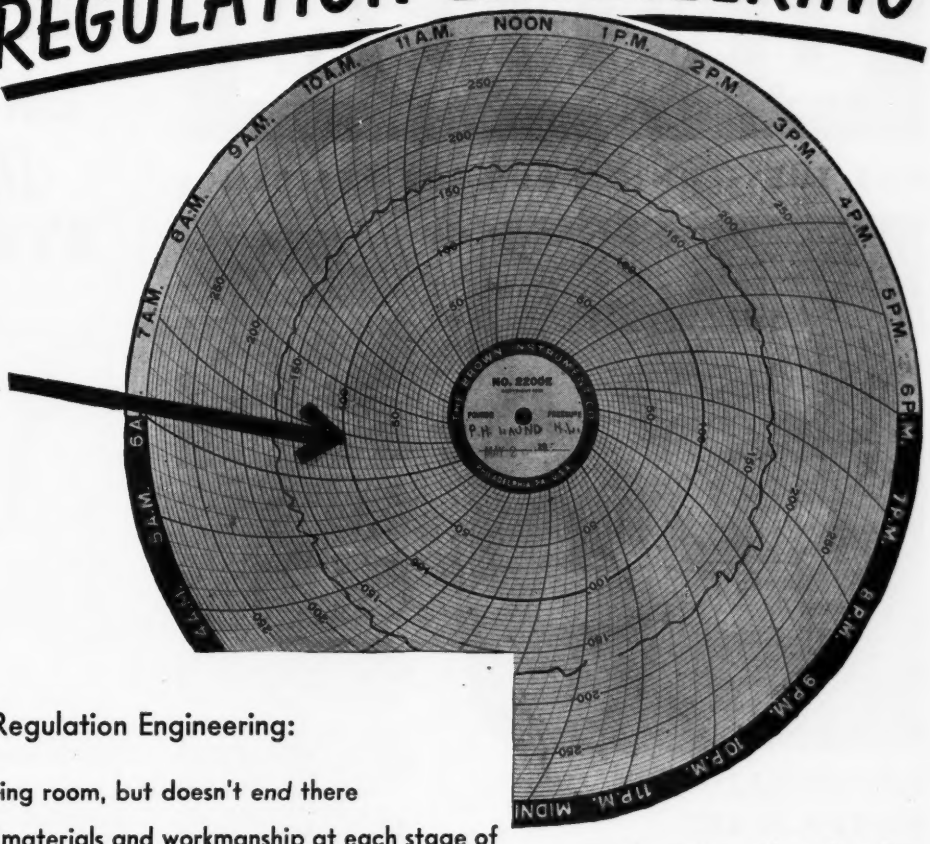
Following in the footsteps of 75 previously named coordinators, who report that the fuel efficiency program is well under way in major industrial areas of the Nation, the new coordinators will organize local advisory committes and direct the work of regional engineers.

With the technical assistance of Bureau of Mines fuel experts, the goal of the program is to minimize fuel losses in industrial and commercial establishments by a more efficient use of fuels and equipment.

In addition to the new coordinators, Dr. R. R. Sayers, Director of the Bureau, announced that two district engineers of the Bureau's Fuel Efficiency Section have established offices in midwestern cities to serve as liaison men between area coordinators. They are Arlen Z. Jennings, Chicago, whose district includes Illinois, Wisconsin, upper Michigan and part of Missouri; and John G. Mingle, at Indianapolis, for Ohio, Kentucky, Indiana, and lower Michigan. The appointment of Raymond C. Johns, vice-president in charge of research for Anthracite Industries, Inc., as a member of the National Fuel Efficiency Council to succeed Harold J. Rose, resigned, also was announced.

The coal shortage for the forthcoming 12 months will be about 35 million tons on the basis of latest estimates. If the goal of the National Fuel Efficiency program is attained, it will result in an approximate savings of 29 million tons of coal.

FOSTER REGULATION ENGINEERING -PAYS OFF HERE



On the button—day after day, month after month, year after year.

Because Foster Regulation Engineering:

- *Starts* in the drafting room, but doesn't *end* there
- Checks quality of materials and workmanship at each stage of production
- Provides competent help in the selection of the *proper* valve for the job
- Gives assistance on correct installation practice for best results
- Follows through with improvements and refinements resulting from constant study of performance of valves in actual service

That's why Foster is the authority on pressure regulation, and why Foster Regulation Engineering pays off in steady, trouble-free operation.

A good book to have at your right hand when regulation problems come up. Ask for Catalog 70.

★ *Bring 'em Back Quicker - Buy More War Bonds* ★

FOSTER ENGINEERING Company

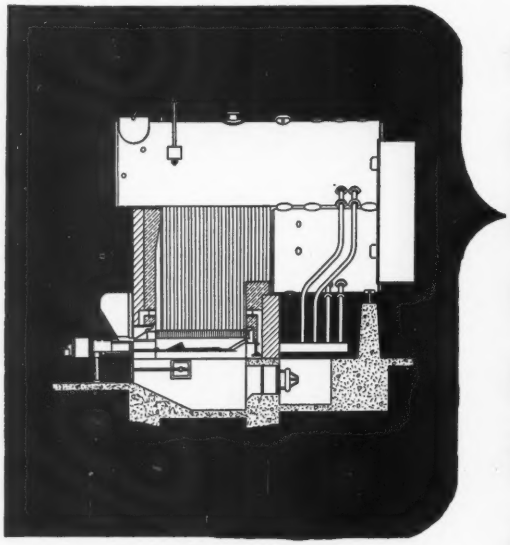
PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

111 MONROE STREET • NEWARK 1, N. J.

8-FE-3

UNION

FILE THESE UNION ADS FOR REFERENCE



- H-TYPE
- A-TYPE
- UNIVERSAL STEEL-CASED
- RADIANT TYPE
- L-TYPE
- 4-DRUM
- O-TYPE
- LONG DRUM
- CROSS-DRUM
- UNIVERSAL BRICK-SETTING
- HORIZONTAL RETURN TUBE
- LITTLE GIANT
- HEATING

UNIVERSAL WATER-WALL STEEL CASED

UNION UNIVERSAL BOILERS are built in several types to 300 H. P.; (1) for Brick Setting, (2) Steel Cased Refractory Lined in Self-Contained Units, (3) Steel Cased with Water Cooled Refractory Side Wall in Self-Contained Units. The patented Pressure Element is common to all. The Union Universal provides a positive, well defined unrestricted circulation, correctly proportioned gas areas and uniform gas velocity, higher heat absorption, larger furnace volume, higher overload capacity and easy accessibility for cleaning. No stay braces and no riveted seams or throat sheet in the fire. Write for bulletins to make selection for your post war boiler.

UNION IRON WORKS ★ ERIE, PA ★

BOILERS

PRESSURE VESSELS • PLATE FABRICATION

VIKING

ENGINE *ALARM* SYSTEMS

TYPE M CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

COMPLETE ALARM SYSTEM

TYPE M-3B

Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT

TYPE C CONTACT MAKERS

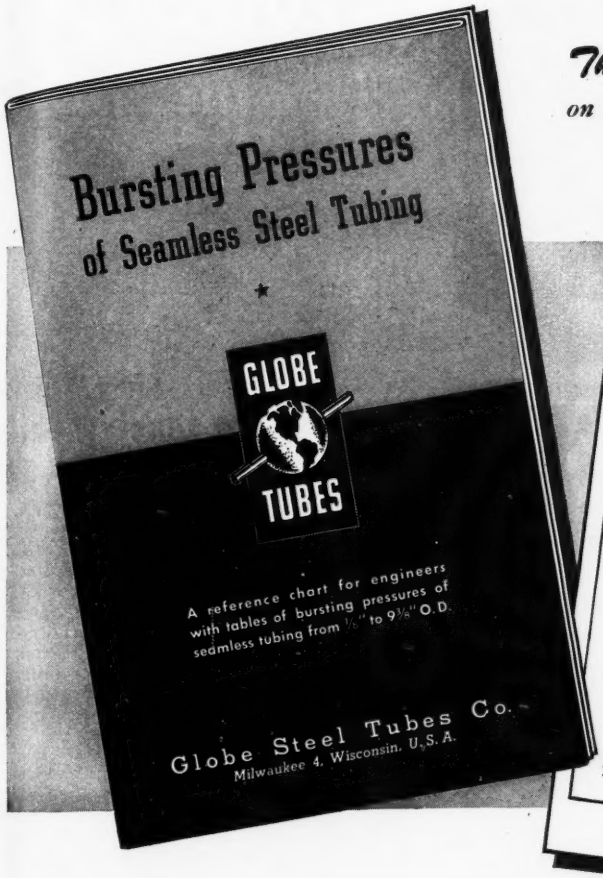
Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

VIKING INSTRUMENTS, INC.
403 Fairfield Ave., Stamford, Conn. Telephone 4-7375

Of Interest to Engineers and other Technical Men

This Valuable Reference Bulletin
on Bursting pressures of Seamless Steel Tubing.


Bursting Pressures
of Seamless Steel Tubing
GLOBE
TUBES
A reference chart for engineers with tables of bursting pressures of seamless tubing from 1/8" to 9 3/8" O.D.
Globe Steel Tubes Co.
Milwaukee 4, Wisconsin, U.S.A.

Bursting Pressure of Seamless Tubing as Determined by Barlow's Formula for a Stress of 10,000 lbs. p.s.i.

Wall Thickness		Outside Diameter in Inches							
B. W. G.	Inches	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32
24	.022	3520	2816	2347	2011	1760	1564	1408	1280
23	.025	4000	3200	2667	2286	2000	1778	1600	1455
22	.028	4480	3584	2987	2560	2240	1991	1792	1629
21	.032	5120	4096	3413	2926	2560	2276	2048	1862
20	.035	5600	4480	3733	3200	2800	2489	2240	2036
19	.042	6720	5376	4480	3840	3360	2987	2688	2444
18	.049	....	....	5227	4480	3920	3484	3136	2851
17	.058	....	....	6187	5303	4640	4124	3712	3375
16	1/16	....	....	6667	5714	5000	4444	4000	3642
	.065	....	....	6933	5943	5200	4622	4160	3782
15	.072	....	....	....	....	5760	5120	4608	4189
14	.083	....	....	....	....	6640	5902	5312	4829
	3/32	....	....	....	....	7500	6667	6000	5455
13	.095	....	....	....	....	7600	6756	6080	5527
12	.109	....	....	....	....	....	....	6976	6342
11	.120	....	....	....	....	....	....	7680	6982

Here is excellent data for engineers and technical men who deal with boiler, still, condenser and heat exchanger tubing and other pressure tubing.

The 24-page booklet contains 16 pages of calculations on tubes in sizes from 1/8" to 9 3/8", outside diameters, and wall thicknesses from 24-gauge to 1 1/2", and a full explanation of the method used in calculating the pressures.

A copy of this informative bulletin is yours for the asking. Write for copy of Bulletin 112 today.

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

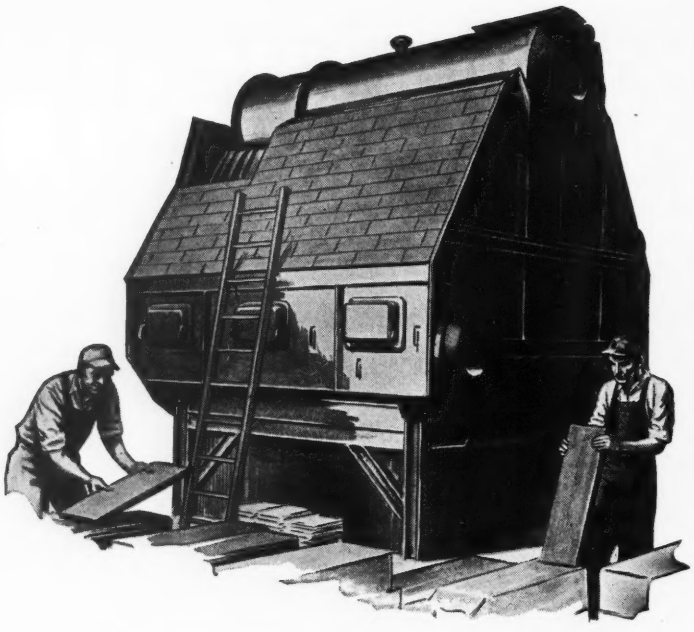
GLOBE TUBES

★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

GLOBE STEEL *Tubes*

5013

GLOBE STEEL TUBES CO., *Milwaukee 4, Wis., U.S.A.*



MONO-BLOCK

A One-block Insulation, Effective Over the Full Temperature-Range

Made from *black* rockwool, B-H Mono-block is high-temperature-resistant (up to 1700° F.) and has exceptionally low thermal conductivity. You'll find it lighter, and more efficient, too, because its long, straight fibres are interwoven in layers by an exclusive, patented process. In each block, millions of tiny air-cells hold back the heat, preventing its escape. Because it is a one-block insulation, Mono-block delivers substantial savings in installation costs, too. Send for sample and new bulletin.

Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, New Jersey; Kalamazoo, Michigan; and Huntington, Indiana.

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

Your Blueprint for

MORE POWER

starts with

OAKITE CLEANING

...Easy Way To Keep Condensing Coils Clean and Scale-Free!

Unless the recirculating spray water used in your evaporative condensers is properly treated, slime and lime-scale is likely to build up on exterior surfaces of condenser coils. When this happens heat transfer capacity is impaired . . . operating efficiency of air conditioning units is reduced.

Try this scale-preventing treatment . . . use Oakite Composition No. 82 as an additive to spray water supply. It prevents slime formation. Due to its lime-solubilizing properties, hard water salts are precipitated in form of soft slush which is easily removed by rinsing. Your air conditioning units will again operate efficiently, ECONOMICALLY!

NEW DIGEST FREE!

NEW Oakite Power Plant Digest describes safe, easy way to remove lime-scale ALREADY formed. Also tells how to clean INTERIOR coil surfaces. Let us send you a FREE copy TODAY!

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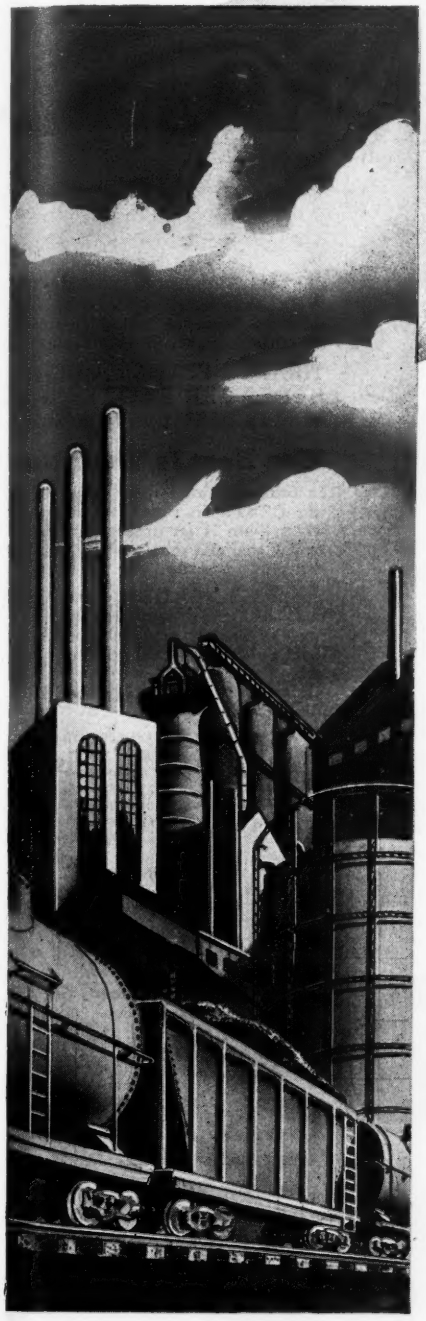
23 Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized cleaning*

Buy Bonds for Victory

MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

CAN YOUR FUEL CHOICE BE...

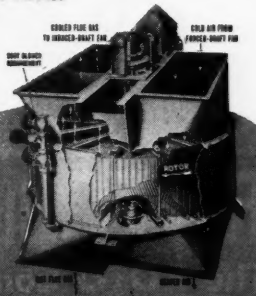


broadened by PREHEAT *Engineering?*

Preheated air has broadened the possibilities of pulverized coal with high moisture content fuels. High temperature air is the key factor to efficient combustion of low-grade fuels with high ash content, and lean fuels such as blast furnace gas. In addition to economies effected by direct heat recovery, more efficient furnace design, made possible by preheated combustion air, results in the same heat from less fuel. It is a "must" for firing with pulverized coal.

ENGINEERING SERVICE

The engineering staff of The Air Preheater Corporation is prepared to assist in applying standard or special types of Ljungstrom Preheaters to your fuel conservation needs, or to help you convert your plant to low-grade, more abundant fuels.



THE LJUNGSTROM AIR PREHEATER

In the Ljungstrom, the heating surface is incorporated in a compact, slowly rotating cylindrical unit. It acts to soak up heat in the chamber through which hot flue gas passes, and then upon rotation, to liberate it to the entering combustion air. Generally the Ljungstrom weighs like these half as much as tubular or plate preheaters of similar capacity. Higher temperatures for special uses are obtainable with the Ljungstrom, up to 1500 degrees F.

THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York

Proved power and endurance for cleaning small tubes

The Roto Company
Newark, N. J.

Gentlemen:

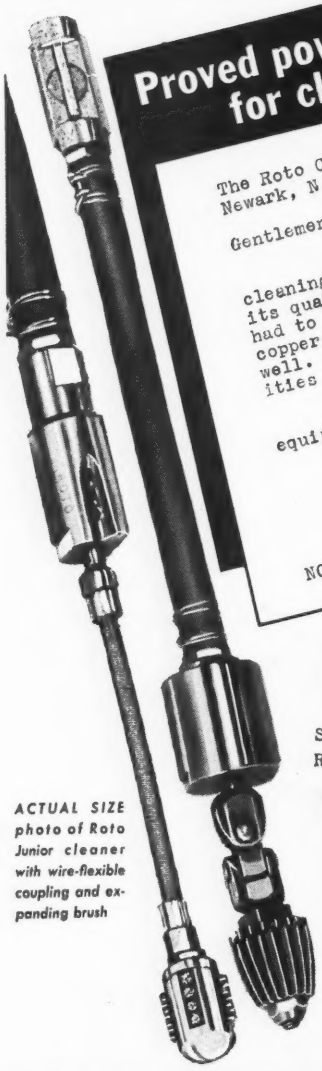
On receipt of your miniature tube cleaning equipment, I was a bit dubious of its qualifications to carry out the job it had to do. It has cleaned 4,000 3/4"x 24' copper-nickel tubes, and has done this job well. All suspicions of its staying qualities have been removed.

I can heartily recommend this equipment. Thanking you.

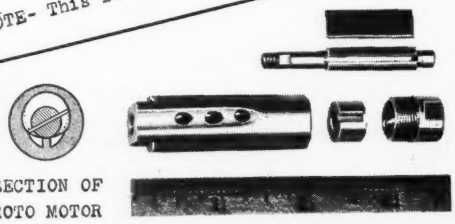
Yours respectfully,

(Signed) Chief Engineer
(Large municipal power plant)

NOTE- This is unsolicited



ACTUAL SIZE photo of Roto Junior cleaner with wire-flexible coupling and expanding brush



SECTION OF ROTO MOTOR

The Secret of the power and endurance of the Roto Junior Tube Cleaner is its extreme simplicity of design and precision construction. It has only two moving parts, a shaft and a solid blade. Positive contact between the blade and the Rotocentric bore cylinder assure an undivided air stream and freedom from leakage. Its convenient size, speed and ease of operation, offer a marked contrast with old type, cumbersome external cleaners. Send for details.

ROTO Junior Tube Cleaners

The ROTO Company, 145 Sussex Ave., Newark 1, N. J.

A Division of Elliott Company

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

TREND TO SPREADER STOKERS

There is a definite trend to the use of more and more Spreader Stokers in small, medium and large Industrial Installations.

WHY do so many engineers now consider the Spreader Stoker superior to all other methods of coal firing?

THE FYR-FEEDER MULTIPLE SPREADER STOKER is the World's BEST Spreader Stoker.

The Best Is Vital Now

In ordinary times it is BEST to get the BEST. In times of emergency, when there is an urgent demand for saving coal and man-power, the BEST is a vital necessity.

The FYR-FEEDER Spray-Spred method of firing combines the advantages of the old-style Spreader Stoker and Pulverized Coal Burner, using only the BEST features of each method plus other FYR-FEEDER advantageous features.

The following questions present themselves:

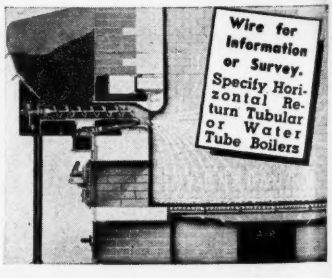
I. *WHY is the FYR-FEEDER superior to all other types of Spreader Stokers?*
II. *WHY is FYR-FEEDER the World's Simplest Automatic Stoker?*
III. *WHY is FYR-FEEDER the best Industrial Bituminous Coal Burner?*
IV. *WHY and how does FYR-FEEDER save coal and manpower?*
V. *WHY and how does FYR-FEEDER reduce maintenance costs?*
VI. *WHY is FYR-FEEDER the best method of burning WET or dry "coal screenings," bug dust or yard sweepings?*

Fyr-Feeder Stoker Sizes

FYR-FEEDER Multi-Burner Stokers are built in sizes that will burn from 300 to 12000 lbs. of coal per hour. If you expect to be in the market for Automatic Coal Burning Equipment—WIRE

FYR-FEEDER

Spreader Stoker Division
American Coal Burner Company
ENGINEERS
22-18 E. Erie St. Chicago 11, Ill.



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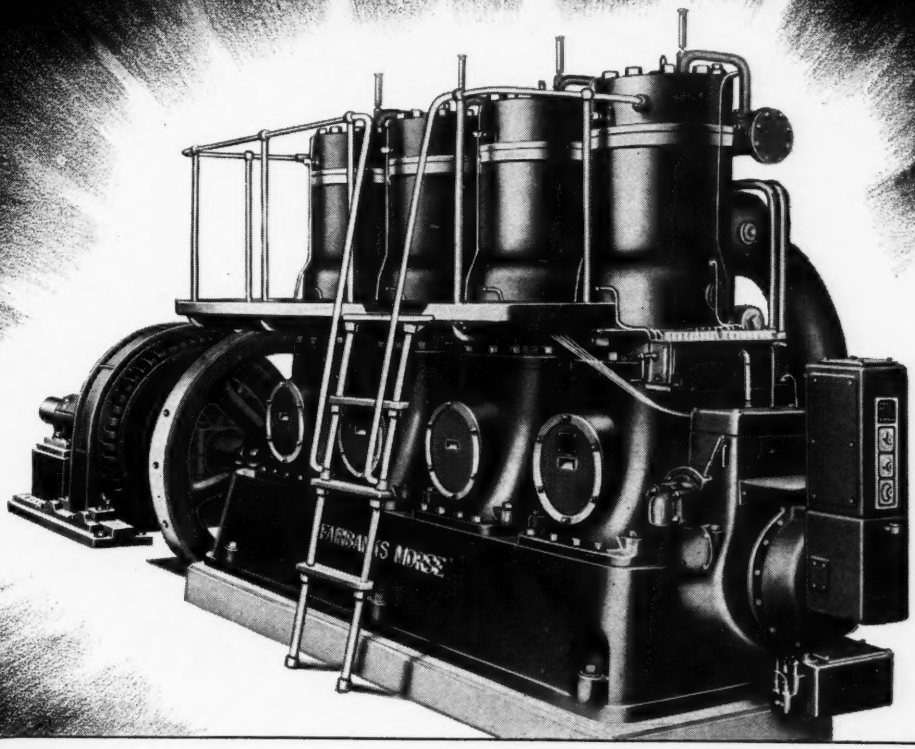
How One 300 Hp. Diesel Saves $9000 a Year



IN 1938 the Superior Packing Company installed one 300 hp. Fairbanks-Morse Diesel.

Since then it has put in 25,000 hours of service with only a few stops for routine inspection.

It operates at better than 90% capacity and overloads are frequent.

Year in and year out, this Fairbanks-Morse Diesel Engine saves over $9,000 a year for the owners. Long ago it paid off its original cost.

What Fairbanks-Morse Diesels have done for others, they can do for you. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
GENERATORS
WATER SYSTEMS
SCALES
STOKERS
FARM EQUIPMENT
RAILROAD EQUIPMENT

F M

Diesels

OF THE COMPLETE LINE...

PYREX HIGH PRESSURE

for use where Temperature Changes are Extreme

You can't use just any Gauge Glass where thermal shock may be encountered—and expect it to stand up. PYREX High Pressure Gauge Glasses are built to withstand sudden temperature changes. In a routine test at Corning, they are heated to 425° F. and plunged into ice water.

They have an exceptionally long life and retain their original crystal clearness, because the special borosilicate glass from which they are made resists the solvent action of steam and hot water. The hard, smooth surface resists scratching.

Because PYREX brand Gauge Glasses are made with machine drawn accuracy, they fit right—there's very little possibility of installation strains.

Pick the one Gauge Glass best suited for your particular requirements from the complete CORNING and PYREX line. Write for Bulletin 817; it tells the whole story on all these glasses and helps you select the right glass for your service. Industrial Division, Dept. PF2 Corning Glass Works, Corning, N. Y.

PYREX brand High Pressure—resistant to thermal and mechanical shock and attack of steam and hot water. Machine drawn accuracy.

PYREX brand Red Line—Same but with added visibility afforded by enameled red line.

PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.

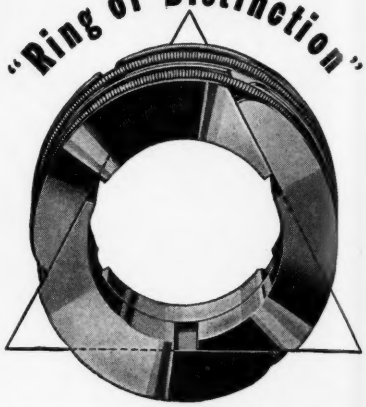
CORNING Standard—For moderate pressures. Long-lasting. Machine drawn accuracy.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses BRAND

"Ring of Distinction"



Install FRANCE Metal Packing for "'Round-the-Clock" Production

The renewal of ordinary packing every few weeks or months increases horsepower and production costs.

Minimum friction is encountered with France Metal "Ring of Distinction" Packing. No undue force can be exerted on rods or stems by tightening the stuffing box stud nuts. The rings are free to float in the case that retains them and are held to the rod or stem with a garter spring having minimum tension.

The result is tight "full-floating", trouble-free performance for years. Prompt delivery assured.

FREE

44-page Catalog of useful and valuable information. Write for your free copy of Catalog M-5, with facts on

- **Packing Designs for Any Service**
- **Installation Procedure**
- **Methods of Lubrication**
- **Pressures and Temperatures**
- **Oil Return and Stripping Rings**
- **Handy Reference Tables**

Request France Engineers to analyze your packing requirements. There is a representative close at hand.

THE FRANCE PACKING COMPANY

Tacony, Philadelphia 35, Penna.

Branch Offices in Principal Cities

Original FRANCE METAL PACKING

CLASSIFIED ADVERTISING

HELP WANTED

The position of Department Superintendent in a large Chemical Company is open to someone with a broad practical experience in organizing and directing large steam, pipe fitting and welding jobs. Applicants must have trade ability as master steam and pipe fitter previous to experience as supervisor of work in maintenance and installations of chemical plants or refineries. Must be thoroughly familiar with high pressure and high temperature steam fitting and modern practice in the fabrication of piping by welding. Only interested in those who have fully demonstrated ability to organize and handle jobs and men. By formal education or extension work must possess engineering ability. Address Box 1450, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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MECHANICAL ENGINEER—Experience required on power plant and general piping design by a large midwest concern manufacturing a wide variety of communication and electronic equipment. In reply submit snapshot, give age, experience and salary expected. Address Box 1448, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

BUY MORE WAR BONDS *NOW*

For Your Alco Heat Exchangers Get Your Replacement Parts from ALCO

HERE'S WHY! ALCO knows every part, every material, every dimension in every ALCO heat exchanger you use... ALCO knows why the materials are what they are... knows every permissible tolerance... knows your ALCO equipment through and through.

It is a distinct advantage to you to buy parts for your ALCO exchangers from ALCO.

ALCO can usually give you *quicker shipment* because ALCO stocks the *right materials*... right for the service and conditions in which your ALCO units operate ... has the equipment, the jigs, the "know-how."

In short:

1. Keep up your equipment by replacing worn or damaged parts *promptly.*
2. Know what you are getting: get your replacement parts from the original manufacturer.
3. For ALCO equipment *always* order replacement parts from ALCO.

Send for this Bulletin, No. 1026

Concise, handy, helpful. Tells how to install, operate, maintain ALCO Heat Exchangers... how to order spare parts. Copy sent promptly on request.

American Locomotive

ALCO PRODUCTS DIVISION

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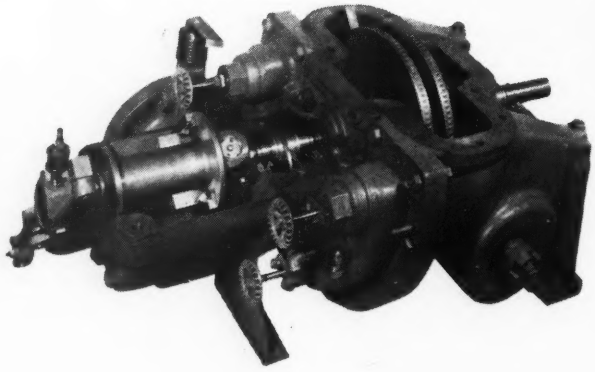
MURRAY

SINGLE STAGE TURBINES FOR MECHANICAL DRIVE



TYPE "U" Murray Turbines may be opened for inspection without disturbing the machine setting. This exposed view shows the mechanical constant speed governor, bolt type emergency overspeed governor, ring lubricated sleeve type babbitt lined bearings. Carbon ring glands are also easily accessible.

A number of wheel sizes with either two or three-row impulse bladed wheels are available. For driving apparatus at low speeds, both integral and separate gears can be furnished. Ratings range from 10 HP up. Ask for Bulletin T-118.

MURRAY ALSO PRODUCES

Multi-stage Turbines—Type UV — Turbine Generators up to 2500 kw
Vertical Turbines—Direct Connected and Geared
Reduction Gears — Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

Waste Pipes Clogged Up?

"MILLER'S" Cleanout Tools are used all over the country by leading engineers for clogged up Drains, Gas Lines, Chemical Lines, Sewers and Toilets. This Miller unit is one of the most efficient ever produced. The high speed gear handle whirls a strong flexible rod through bends, angles, traps and elbows—driving through stoppages in a jiffy. It will use a ¼-inch, ⅜-inch, or $\frac{5}{16}$-inch rod and accommodate as much as 30 feet. Guaranteed to do the job.

Send For Our New Catalog Today

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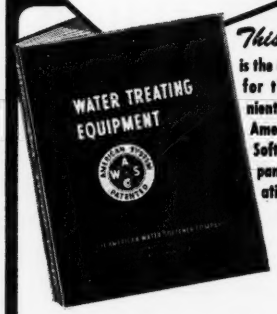
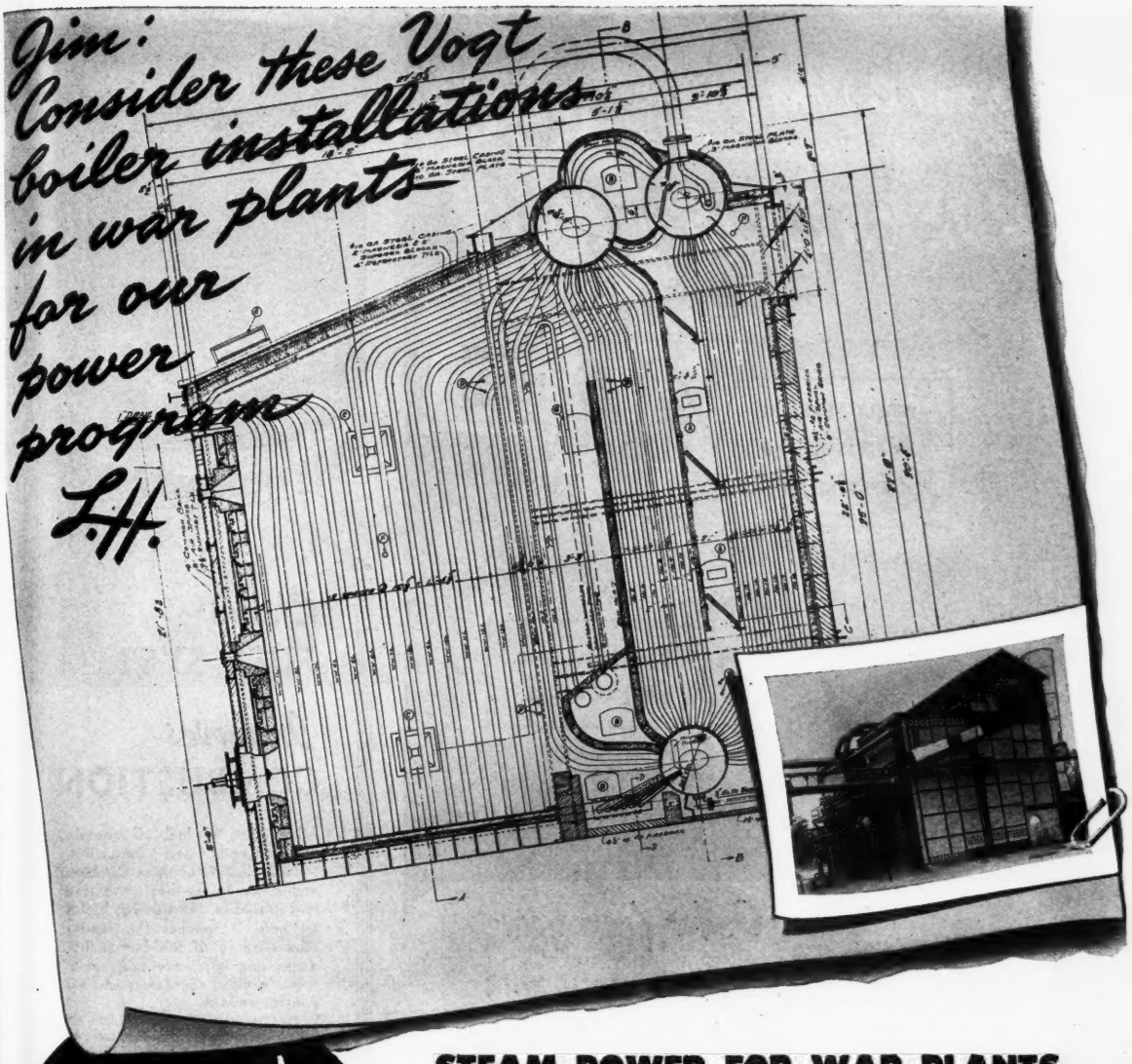


This is the new binder for the convenient housing of American Water Softener Company's informative Bulletins

Under War-Time conditions we could only obtain a limited number. If you want one . . . write to us . . . we can not guarantee to be in a position to send it.

THE AMERICAN WATER SOFTENER COMPANY
LEHIGH AVENUE and FOURTH STREET
PHILADELPHIA • PENNSYLVANIA

Jim: Consider these Vogt boiler installations in war plants for our power program
L.H.

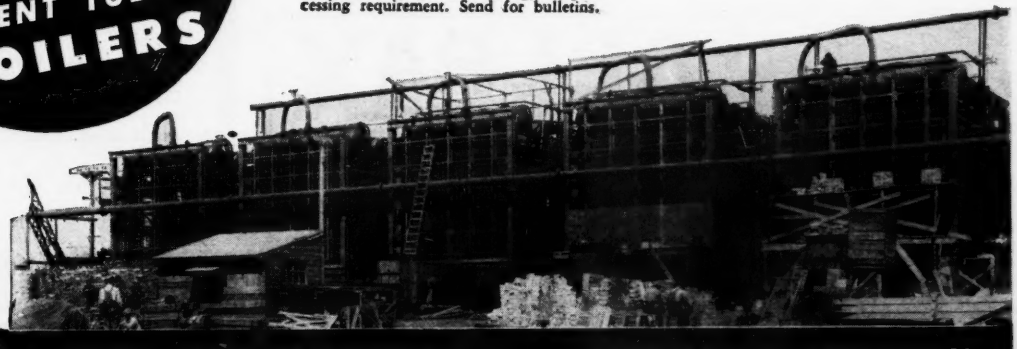


Vogt
CLASS VR BENT TUBE BOILERS

STEAM POWER FOR WAR PLANTS

These Oil and Gas Fired Steam Generators are working round-the-clock in war plants producing 100 octane gasoline and synthetic rubber components . . . all vital to Victory!

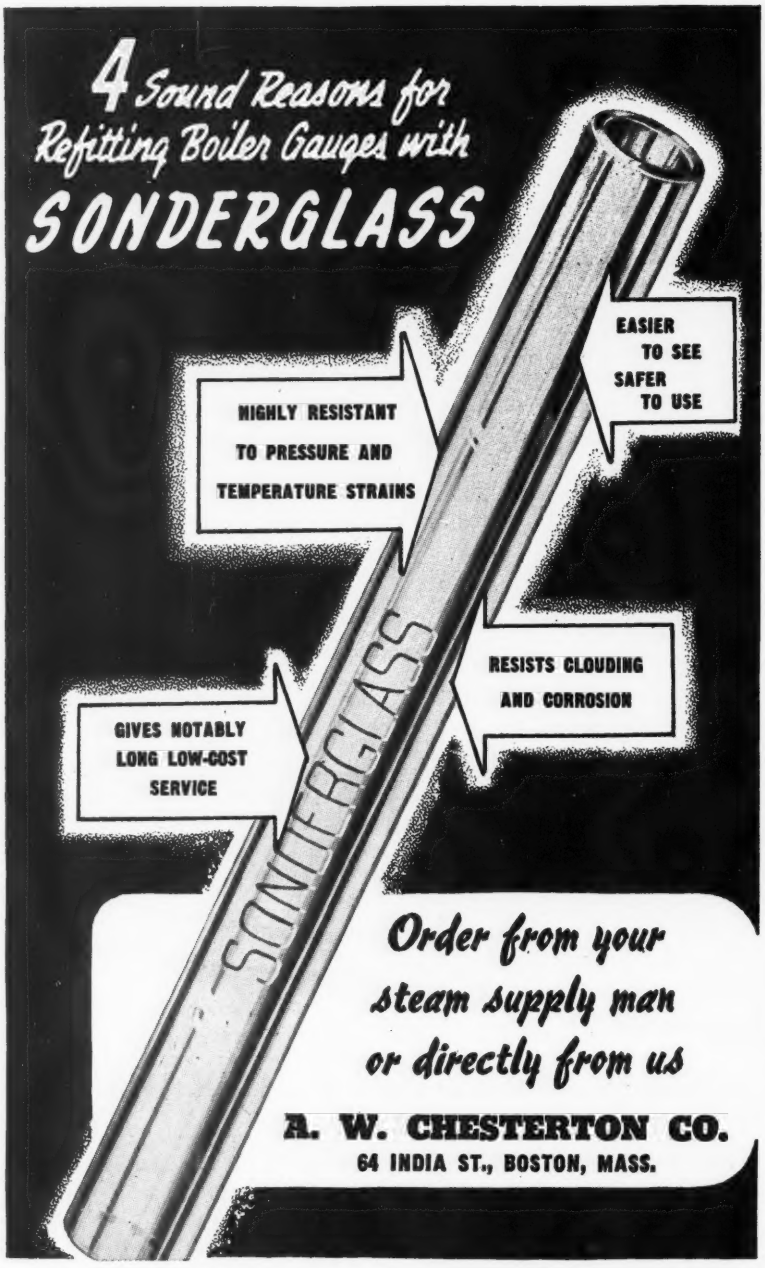
Vogt builds steam generating equipment to meet every power, heating, or processing requirement. Send for bulletins.



HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY

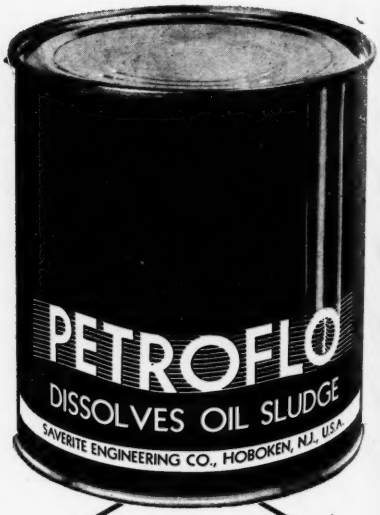
Branch Offices: New York - Chicago - Cleveland - Philadelphia - Dallas

4 Sound Reasons for Refitting Boiler Gauges with SONDERGLASS


HIGHLY RESISTANT TO PRESSURE AND TEMPERATURE STRAINS
EASIER TO SEE SAFER TO USE
RESISTS CLOUDING AND CORROSION
GIVES NOTABLY LONG LOW-COST SERVICE
SONDERGLASS

Order from your steam supply man or directly from us

A. W. CHESTERTON CO.
64 INDIA ST., BOSTON, MASS.



Cleans FUEL SYSTEM

Improves COMBUSTION

All grades of fuel oil contain carbon ends and impurities. Minute clusters of these combine and settle to the bottom of the tank as sludge. This sludge builds up until it reaches the feeder pipe leading to the burner tip, decreasing efficiency and, sometimes, causing shutdowns and expensive repairs.

Sludge removal by manual or mechanical methods is costly and time-consuming, especially in underground tanks. By adding 1 lb. Petroflo to each 1000 gals. (23 bbls.) while the fuel is pumped into the tank, sludge-forming carbon ends and impurities are maintained in suspension, assuring a steady, free flow of oil, which results in better atomization, and produces a soft, even, efficient flame.

Petroflo also dissolves sludge already in the tanks and fuel system, and keeps them clean. The cost of Petroflo is insignificant, considering the many benefits it offers.

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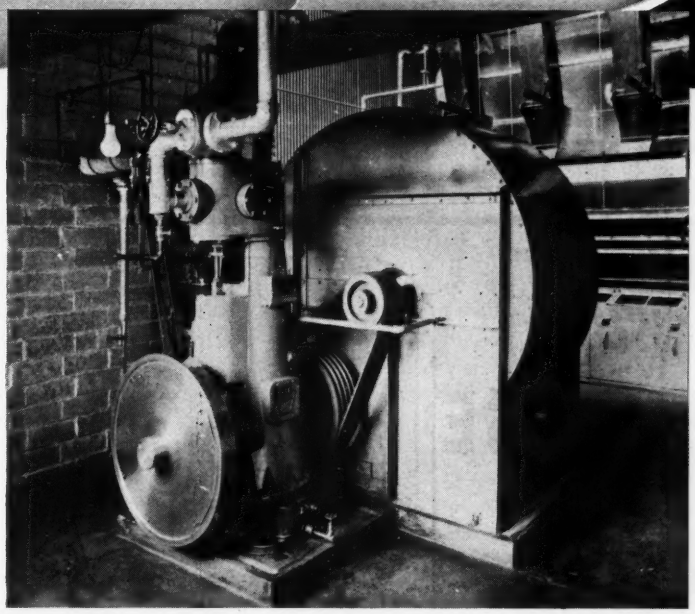

IN generating steam for heating or processing purposes, you also generate power. You waste this power when the steam is used only for its prime object of heating. A Troy-Engberg Steam Engine will extract this power—it's really By-Product Power—and give you a reliable drive for which you are now probably purchasing power. Elementary, you say? It's surprising how many plants are overlooking "By-Product" power possibility.

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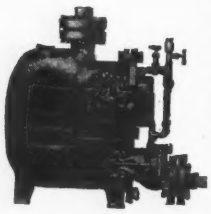
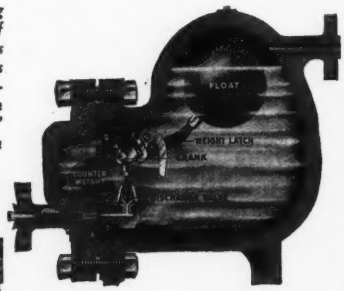
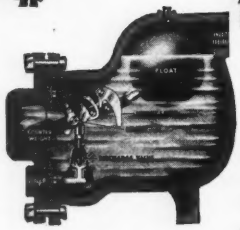
And Peak Production is Proving AGAIN That NICHOLSON TRAPS Meet All Requirements, Beat Many Specifications

The outstanding performance of Nicholson Traps in war plants has won them a permanent place in the "peace plans" of industry from coast to coast.





There's a Nicholson trap for practically all purposes. Above, Piston-Operated Steam Trap. Right, Model "JR" Compressed Air Trap.



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A large capacity trap for pressures to 1500 lbs. at 1000 degrees maximum temperature. Positive automatic intermittent action. Quick opening and closing valve. Water - sealed discharge.

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Also See Sweet's

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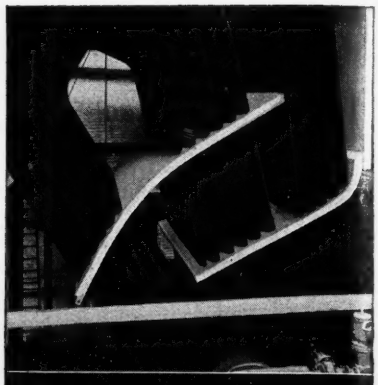

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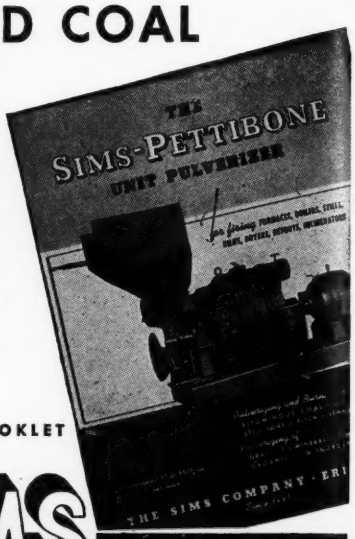

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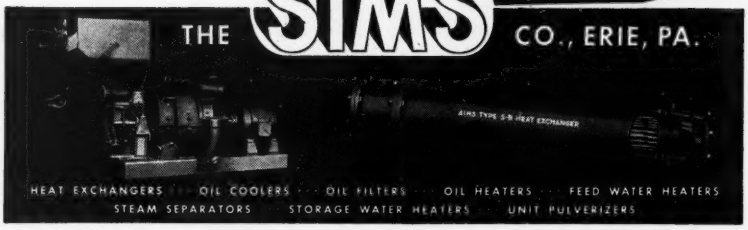
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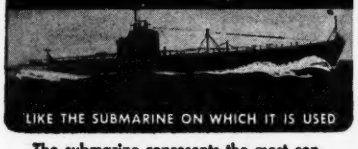

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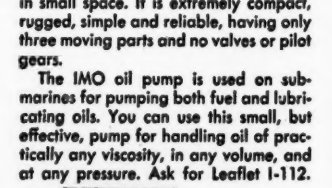

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **All Purpose Stoker**—Bulletin No. 500 describes advantage of the Canton De Luxe worm feed stoker for small and medium sized industrial and commercial applications. Features include side ash dumps, extra grate area, zoned air control, dur-alloy steel hopper. Canton Stoker Corp.

2 **Firebox Boilers**—Descriptive Bulletin tells about the Titusville firebox boilers for coal, oil or gas operation. Based on your special power-heating needs, Titusville engineers will present blue prints for boilers you need for new installations or replacements. Struthers Wells Corp., Titusville Boiler Div.

3 **Coal Handling**—Pictured in Catalog 19 are many interesting coal handling jobs done with Crescent scraper buckets. Built in capacities one-third to 10 cu yd; will stock out and reclaim coal and similar materials weighing not more than 60 lb per cu ft. Sauerman Bros., Inc.

4 **Furnace Enclosures**—New data book gives complete description and construction principles of Detrick furnace enclosures; also suggestions for modernizing present walls and arches. M. H. Detrick Co.

5 **Stokers For Low Cost Fuels**—Having re-entered the chain grate stoker field, The McClave Co. has issued a new bulletin describing equipment for burning the smaller and cheaper sizes of solid fuel. Replaceable links, mechanical siftings remover, and improved spur gear drive are among features described.

6 **Integral Furnace Boiler**—Illustrated Bulletin G-34A gives complete data on integral furnace boiler, either stoker firing or oil burning. Can be quickly converted to burn whichever is the more economical fuel. Sizes from 1353 to 6506 sq ft heating surface. The Babcock & Wilcox Co.

ELECTRICAL

7 **Electronic Relay**—General Electric Co. 8-pg Bulletin No. GEA-4214 gives description, operation and application of CR-7511-A electronic relay.

8 **Rechargeable Flashlight Batteries**—One rechargeable storage battery is said to outlast 400 dry cells. Made to fit any standard size flashlight case using 1¼-in. size D dry cells. Charger—available in 1, 6, or 12-cell sizes—plugs into any light socket. Write for Bulletin FBB 1242. Ideal Commutator Dresser Co.

9 **Making Motors Last**—"Hints to Make Motors Last" is the title of handy little booklet for engineers and maintenance men. Check chart tells what to do when motor fails to start, runs hot, is noisy, shows excessive brush wear, etc. Westinghouse Electric & Mfg. Co.

10 **Insulation Tester**—The new U. S.-made "Megger" insulation tester, in plastic molded case, and said to have the same ruggedness and accuracy common to all "Megger" instruments, is described in new Bulletin 1735-PE. James G. Biddle Co.

FANS, PUMPS AND COMPRESSORS

11 **Refrigeration Compressors**—Bulletin No. C-1100-B18 contains specifications of Worthington Type VSA vertical two-cylinder single-acting inclosed refrigeration compressors, in 8 by 8-in., 9 by 9-in. and 10 by 10-in. sizes. 6-pg Bulletin No. C-1100-B19 covers same compressors in 6 by 6-in. and 7 by 7-in. sizes. Worthington Pump & Machinery Corp.

12 **Steam Heat Vacuum Pump**—Specifications, sizes and capacities of Warren steam heat vacuum pumps are given in new Bulletin 226-1. Rigidly supported valve gear may be adjusted while pump is in operation. Warren Steam Pump Co.

13 **Pump Packing**—How Darcova pumcups installed in reciprocating pumps pay off in longer packing life, fewer shutdowns and lower power costs is explained in new Bulletin No. 4105. Contains application diagrams, performance charts. Darling Valve & Mfg. Co.

14 **Handbook On Centrifugal Pumps**—Allis-Chalmers' new pump maintenance handbook gives a grand "refresher" course in alignment problems, figuring head, making bearings last longer, preventing cavitation, etc. Applies to all makes of pumps. Allis-Chalmers Mfg. Co.

INSTRUMENTS AND CONTROLS

15 **Electronic Feed Water Control**—How the Fireye electronic control maintains boiler water level automatically—provides low-level alarm and fuel cut-off in oil or pulverized coal burners is described in Catalog No. 50. Combustion Control Corp.

16 **Propeller Type Flow Meter**—Bulletin 350 pictures and describes ten operating features of Builders Propelofio meter for main line metering. Low cost and accurate performance (within plus or minus 2 per cent) recommend it for many applications, including chemical feeder control. Builders-Providence, Inc.

17 **Temperature and Humidity Controls**—A complete line of self-operating and air operated controls for accurate and dependable automatic temperature and humidity control for industrial processes, heating or air conditioning systems is described in circular 2520. The Powers Regulator Co.

18 **Gages for All Kinds of Liquids**—Bulletin 1037 describes a complete line of liquid level gages for measuring liquids of all kinds whether light or heavy. Dial readings can be provided in feet, inches, gallons, pounds, liters or by any other desired increment. By using these gages accurate inventory of liquids is constantly available. The Liquidometer Corp.

19 **Temperature and Pressure Control**—Details of the Thermoswitch are graphically explained in new 44-pg catalog. This device is based on new principles of heat and cold control in which expansion or contraction of the shell causes contact action. May be used throughout the entire range of temperature control work, from sub-zero to 1200 deg F. Various types have been designed for the control of temperatures of solids, gases, and liquids. A section of the catalog covers "The Selection and Application of Thermoswitches;" is illustrated with actual temperature charts and diagrams. Fenwal, Inc.

LUBRICATION

20 **Centralized Lubricating Systems**—New booklet describes the Alemite LubroMeter, a simple form of centralized lubrication which has only two moving parts in its valves, and satisfactorily handles both oil and grease. It may be serviced from hand or power operated portable type guns, and is also available as a fully automatic system. Alemite Div., Stewart-Warner Corp.

21 **Constant Level Oilers**—Bulletins No. 24-A and 25-A describe an automatically controlled visible oiling method for ring or ball bearings, shafts, gear and pump housing, etc. Valuable suggestions on how to end bearing failures—reduce motor burnouts—stop needless shutdowns for hand-oiling—eliminate fire and accident hazards, etc, are given. Write for your free copy. Trico Fuse Mfg. Co.

22 **Oil Reclaimer**—4-pg Bulletin No. YM-700 discusses the new Robot oil reclaimer, in capacities ranging from 4 to 300 gal per hr. Youngstown Miller Co.

23 **Industrial Lubricants**—Helpful publication entitled "The Service Factor" is devoted to the solution of lubrication problems and describes specialized lubrication, steam cylinder and valve oils, etc. Sinclair Refining Co.

24 **Positive Mechanical Lubrication**—Bulletin No. 25, newly published by The Farval Corp. describes theory and practice of mechanical lubrication. It opens with a study of the machinery lubrication problem and of the economies of a system which delivers lubricant to all bearings in exact measured amounts. This information is faced by a large close-up of a Farval manual dualine system at work. Center spread features advantage of positive mechanical lubrication; and photos on concluding pages suggest methods of locating and mounting pumping units and feed lines on 24 different kinds of machinery.

MECHANICAL TRANSMISSION

25 **Gear Data Book**—Combination catalog and gear data book, 72-pg includes dimension tables for various gear types, as well as data on speed reducing units, motoreducers, and electric hoists. Also contains practical engineering data section. Philadelphia Gear Works.

List Items You Want On Handy Coupon On Following Page

26 **Handbook On Belting Problems**—A new Tannate Handbook has been put out to help with belting problems. It gives information on short center, modern group and individual drives; tells how to lace belts or make them endless; offers suggestions for improving belt drives, aligning pulleys and belt care. Contains many tables and diagrams. This useful book is free for the asking to those concerned with belt maintenance. J. E. Rhoads & Sons.

27 **Quick Detachable Sheaves**—The Worthington "QD" sheave—easy to get on, easy to get off—is described in new 16-pg illustrated bulletin. Contains installation views, dimension tables and data of value to engineers with power drive problems. Worthington Pump and Mach. Corp.

PIPING, VALVES AND FITTINGS

28 **High Pressure Tubing**—New Bulletin No. 443 tells about Summerill tubing specialties including fuel injection tubing for Diesel engines, heavy-wall tubes for high pressure applications, special processed carbon and stainless steels for hydraulic lines. Table lists analyses and properties of various tubing steel and alloys. Summerill Tubing Co.

29 **Sediment Strainer** — Bulletin No. 89-4 decribes a new Y type sediment strainer in the 125 lbs Std. with semi-steel body and removable, perforated, non-corrosive metal screen, in pipe sizes from ½ in. to 2 in. inclusive with screwed ends, which has been added to the Adsco line of steam specialties. American District Steam Co.

30 **Valve Do's and Don'ts** — Eleven good tips on the handling and care of valves are graphically illustrated in the new "Do's and Don'ts" Chart just released by the Reading-Pratt & Cady Div. of the American Chain & Cable Co., Inc. Simple data in these new 11x17 in. charts is illustrated by graphic sketches portraying the right and wrong way to handle each situation. Excellent for new workers, they also help refresh old hands on valve uses.

31 **Welding Fittings**—As much a text book as a catalog, 216-pg presentation gives a wealth of information on welding fittings and forged steel flanges. Contains engineering data that will prove invaluable to the man who purchases, designs or specifies piping, fittings and flanges in carbon and alloy steels. Taylor Forge & Pipe Works.

32 **Precision Bore Glass Tubing**—How the Glo-Tech process provides strong, corrosion-resistant, precision-bore glass tubipg is described in Catalog 95-A. Photos show various shapes and applications in laboratory and factory. Fisher & Porter Co.

33 **Cast Steel Flanged Fittings**—Bulletin No. 544 pictures and gives dimensions on PTP carbon and alloy cast steel flanged fittings. A valuable reference for design engineers and maintenance men. Pipe & Tube Products, Inc.

34 **Valve Operating Hints**—New publication Yarway News contains helpful hints on how to add packing to a gun-pakt joint while under pressure—how to operate a seatless and hard-seat tandem valve—how to figure sizes of steam traps used on steam mains, etc. Also tells of latest metallurgical developments for high pressure valves. Yarnall-Waring Co.

35 **Water Hammer Prevention**—Interesting folder "Water Hammer—Cause, Effect and Control in Piping System" tells how Williams-Hager flanged silent check valves cure noisy lines, insure constant flow of liquids. The Williams Gauge Co.

36 **How Air Inlet Valves Protect Gravity Flow Lines**—New 12-pg Bulletin 125 provides facts for engineers on the installation and operation of Simplex air inlet valves on thin-walled gravity flow lines to prevent possibility of collapse as a result of sudden drops in the pressure in the pipe line. Charts and tables are given for determination of the correct positioning, frequency, and size of the air inlet valves required for trouble-free operation of the gravity flow line. Simplex Valve & Meter Co.

PRIME MOVERS

37 **Single and Multi-Stage Turbines**—Fresh from the press, Bulletin S-140 tells about the operating advantages of Terry turbines for driving generators, pumps, compressors, geared fans, coal pulverizers, line shafting, etc. Complete line provides for applications from 5 to 2000 hp. The Terry Steam Turbine Co.

38 **Diesel Engines**—12-pg catalog describes new Hendy Series 50 stationary and marine diesels. Booklet contains specifications and power curves at speeds ranging from 400 to 600 rpm. Chart shows general dimensions. Joshua Hendy Iron Works.

39 **Engine Silencers**—Bulletins D125, D127 tell where and how Maxim silencers are used for the exhaust or intake of internal combustion engines, steam engine exhausts, air compressor intakes, etc. The Maxim Silencer Co.

WATER TREATMENT

40 **Chemical Treatment of Boiler Water**—That is the title of Betz Technical Paper No. 84 which presents a helpful discussion of the causes of boiler scale, corrosion, carryover and embrittlement. Also deals with the applications and limitations of commercial chemicals employed for the correction of these difficulties. W. H. and L. D. Betz.

41 **Industrial Cleaning Service**—Bulletin tells about the development of Dowell chemical method for removing water- or steam-deposited sludge and scale from all types of industrial equipment. Lists actual results of this cleaning service in boilers, condensers, water lines, economizers, distillery, blast furnace. Contains typical hookup diagram. Dowell, Inc.

42 **Water Treatment**—A reprint of a paper, "A New Index for Determining Amount of Calcium Carbonate Scale Formed by a Water" is available free to readers. Deals with scale problems in engine jackets, boiler feed water heaters, ammonia condensers, air conditioning equipment, etc. National Aluminate Corp.

43 **Scale and Corrosion Control**—Interesting stories of how D. W. Haering & Co., Inc., corrected and controlled scale, corrosion and algae in several well-known industrial plants are published in recent bulletin "HOH Lighthouse."

MISCELLANEOUS

44 **Belt Conveyor Idler Book**—A new 16-pg illustrated Book No. 1915 announces the "100" Link-Belt anti-friction idler for belt conveyors and gives detailed information. Types include troughed carrying-run idlers; flat-roll carrying and return idlers; troughed self-aligning idlers; and self-aligning return idlers. Dimensions, weights and list prices are given. Link-Belt Co.

45 **Resurfacer for Concrete Floors**—How Ruggedwear resurfacer repairs worn concrete and wooden floors ready for traffic in 36 hr is described in new booklet. Also tells about Awog, new development in acid, water, oil-resistant floors. Flexrock Co.

46 **Free Repair Handbook**—Company offers free 40-pg guide for the use of Smooth-On cements, containing 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

47 **Spiral Wound Gaskets**—Ajax spiral wound gaskets for pressures from 10 psi to 3500 psi are described and illustrated with specifications, prices, etc., in Catalog 202. This construction involves the winding of a single strip of metal ply, preformed into a U-shaped groove. Between each metal winding are inserted two parallel thicknesses of asbestos filler. United States Gasket Co.

48 **New Portable Weld Testing Machine**—Booklet describes operation of an improved portable weld testing machine introduced by the Air Reduction Sales Co. This machine is said to be the only available portable-type unit that performs all these three weld tests: 1. Reduced section transverse tension test; 2. Guided bend test (a complete 180 deg face or root bend); 3. Longitudinal all-weld metal tension test (0.505 in.).

49 **Refrigeration Data Book** — York Corp. has just issued a new catalog of accessories and supplies for refrigeration and air conditioning plants. Book gives quick, complete "finger-tip" information under the following headings: accessories and supplies, ice cans and air fittings, valves and fittings, oil, cold storage doors, renewal parts, tables and data. Under the latter, sizes, weights, performance data, net prices, photographs, mechanical drawings, descriptions, and so forth, have been included.

★ **Handbook on Leather Packings**—Just off the press is the revised edition of the Houghton Handbook on Hydraulic and Pneumatic Leather Packings. Contains helpful hints on applications and maintenance; also temperature conversion tables, decimal equivalents and other reference data. May be obtained only by writing direct to the manufacturer on company letterhead. E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

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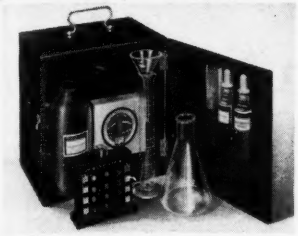

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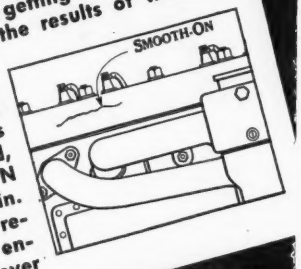

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Power Plant Construction News

Calif., Los Angeles—General Petroleum Corp., 108 West 2nd St., Los Angeles, plans expansion in oil refinery and gasoline plant in Torrance district, including new twin-unit cracking plant for gasoline division. Electric power equipment will be installed. Entire project is reported to cost over $5,000,000. M. W. Kellogg Co., Figueroa and 190th Sts., Gardena, Calif., is engineer.

Calif., Pasadena—Board of Directors, California Institute of Technology, has approved plans for new one-story hydrodynamics laboratory, with basement and sub-basement, 70 x 85 ft, to cost approximately $70,000, with equipment. Work will begin soon. Project has a priority rating.

Conn., Norwalk—Norwalk Tire & Rubber Co. plans installation of electric power equipment in connection with expansion in plant for manufacture of rubber soles and heels for Government. Cost estimated about $200,000, with financing provided by Defense Plant Corp., Washington, D. C. Work is scheduled to be carried out at once.

Ill., Joliet—Bureau of Yards and Docks, Navy Dept., Washington, D. C., has plans maturing for remodeling and improving boiler plant at naval station at Joliet, with installation of equipment for increased capacity, and for ventilating system for Bldgs. Nos. 1331 and 1332. Public Works Office, Naval Training Station, Great Lakes, Ill., in charge. Cost reported about $250,000. Burnham & Hammond, 160 North LaSalle St., Chicago, Ill., architects.

Ind., South Bend.—Studebaker Corp., South Bend, is completing plans for new one-story addition to automobile body works. Electric power equipment will be installed. Cost reported over $175,000, with machinery. Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich., is architect and engineer. Project will have a priority rating.

Iowa, Thompson—Winnebago Rural Electric Cooperative Assn., Thompson, plans extensions in rural electric system in parts of Winnebago County, with service connections and other operating facilities. Cost about $70,000, with financing arranged through Federal aid.

Ky., Russell—Kentucky-West Virginia Power Co., Ashland, Ky., plans rebuilding of Bellefonte power substation, near Russell, recently damaged by fire, with loss reported close to $50,000, including equipment.

Me., Thomaston — Lawrence Portland Cement Co., Thomaston, plans installation of electric power equipment in new addition to local mill. Cost reported over $90,000. Work will begin soon. Project has a priority rating. Main offices are at 150 Broadway, New York, N. Y.

Md., Baltimore—Holtite Mfg. Co., Warner and Ostend Sts., manufacturer of rubber soles and heels, plans installation of electric power equipment in connection with expansion in plant for increased production for Government. Cost estimated about $360,000, with financing by Defense Plant Corp., Washington, D. C. Work will be carried out at once.

Mich., Sault Ste. Marie—City Council has authorized surveys and estimates of cost for new municipal steam-generating station for central heating service. It is understood that project will be carried out as a postwar development. Smith, Hinchman & Grylls, Inc., Marquette Bldg., Detroit, Mich., is consulting engineer.

Minn., Detroit Lakes—A group of dairies and creameries at Audubon, Lake Park, Frazee and Hawley, represented by Henry T. Johnson, Audubon, chairman of committee, has plans under way for new cooperative milk-drying plant at Detroit Lakes, consisting of main one-story unit and several auxiliary structures. Electric power equipment will be installed. A power house is planned. Cost close to $180,000, with machinery. Project has secured a priority rating.

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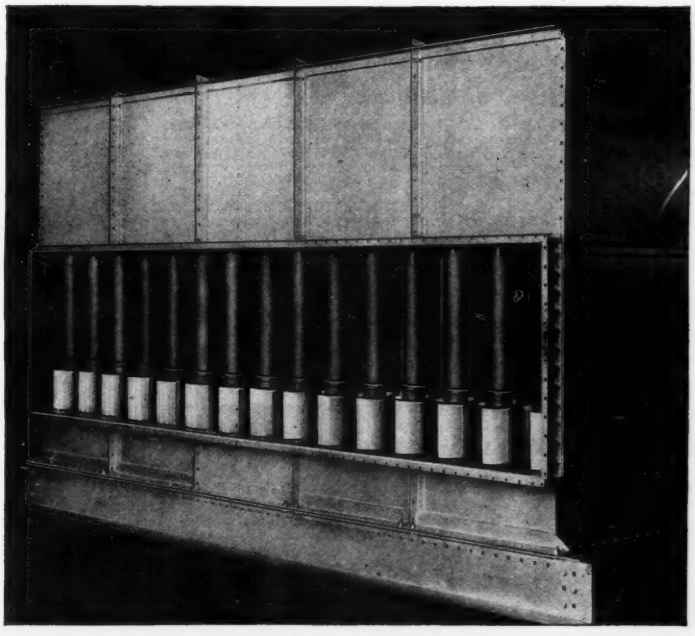

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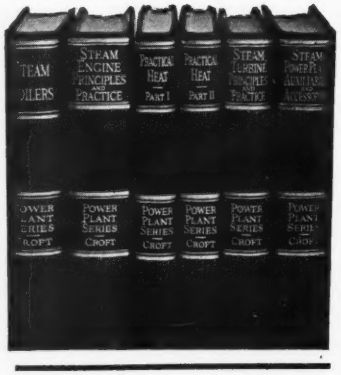
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Mont., Great Falls—Montana Vegetable Oil & Feed Co., Great Falls, plans installation of electric power equipment in new one-story seed processing mill on local site. Cost reported about $100,000, with machinery. It is understood that project will have a priority rating. J. R. Simpson is general manager.

New York, Johnson City — Endicott-Johnson Corp., Endicott, N. Y., manufacturer of boots and shoes, plans expansion in power plant at Johnson City, where branch factory is operated, with installation of new 850-hp boiler and auxiliary equipment. This is part of large development program at that place, where new plant, 200 x 500 ft. will be erected for manufacture of rubber soles and heels for Government. Electric power equipment will be installed. Entire project will cost over $2,000.000, with financing by Defense Plant Corp., Washington, D. C. Elwyn E. Seelye & Co., 101 Park Ave., New York, N. Y., are consulting engineers.

Ore., Portland—Northwestern Ice & Cold Storage Co., 73 S. E. Washington St., will modernize and improve a four-story, block-square building at Everett and Davis Aves., 13th to 14th St., for new cold storage and refrigerating plant for service for Government. Cost about $700.000, with financing provided by Defense Plant Corp., Washington, D. C. Of such amount, more than one-half will be used for machinery and equipment installation.

Ore., Vernonia—West Oregon Electric Cooperative, Inc., Vernonia, plans rural electric system totaling about 277 miles in parts of Columbia County, with service connections and other operating facilities. Also will purchase two generating stations now located in line area, and will make extensions and improvements, including equipment installation; and will also acquire about 75 miles of existing lines, likewise to be improved. Entire project will cost about $460,000. Financing has been arranged through Federal aid.

Tenn., Memphis—Missouri Portland Cement Co., 3615 Olive St., St. Louis, Mo., plans new cement mill on 30-acre tract of land on North Thomas St., Memphis, recently acquired. It will comprise several large units, equipped for initial annual rating of 750.000 bbl. Electric power equipment will be installed. A power house will be built. Cost reported about $2,500,000. Application has been made for a priority rating.

Texas, Houston—Sheffield Steel of Texas, Industrial Rd., will carry out expansion in plant for production for Government, with machinery and facilities for increased capacity. Electric power equipment will be installed. Entire project will cost about $450 000, with financing provided by Defense Plant Corp., Washington, D. C. Work will begin at early date.

Wash., Everett—Soundview Pulp Co., manufacturer of bleached sulphite pulp, plans addition to plant for by-products unit for production of commercial alcohol from waste sulphite pulp liquor. It will consist of several large units. Electric power equipment will be installed. Cost estimated about $1,300,000. Application has been made for a priority rating.

Wis., Eau Claire—Water Dept. has plans under way for new pumping station on Chippewa River, in connection with extensions in water system, including motor-driven pumping units, controls and accessory equipment. No estimate of cost announced. Greeley & Hansen, 6 North Michigan Ave., Chicago, Ill., are consulting engineers. A. R. Garnock is city engineer.

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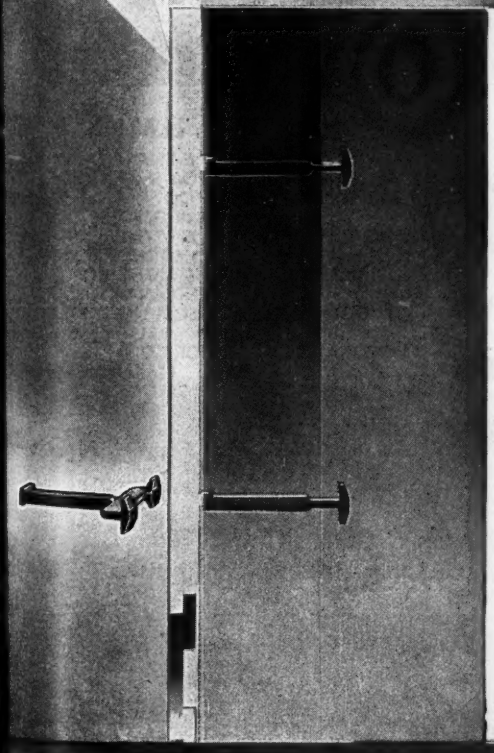

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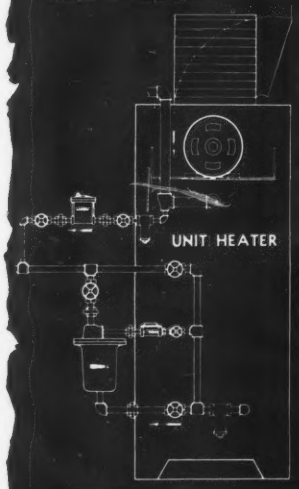

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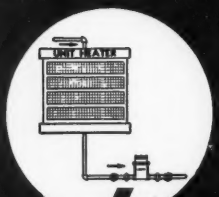

Accumulated condensate and trapped air can make unit heaters slow in starting. Uncertain drainage can seriously reduce heat output.

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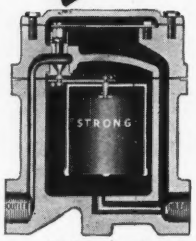

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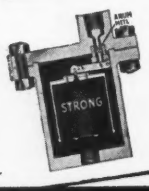

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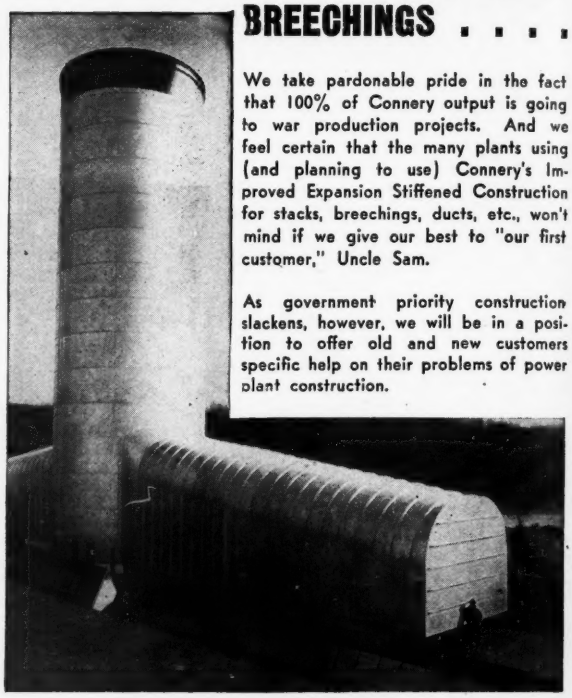

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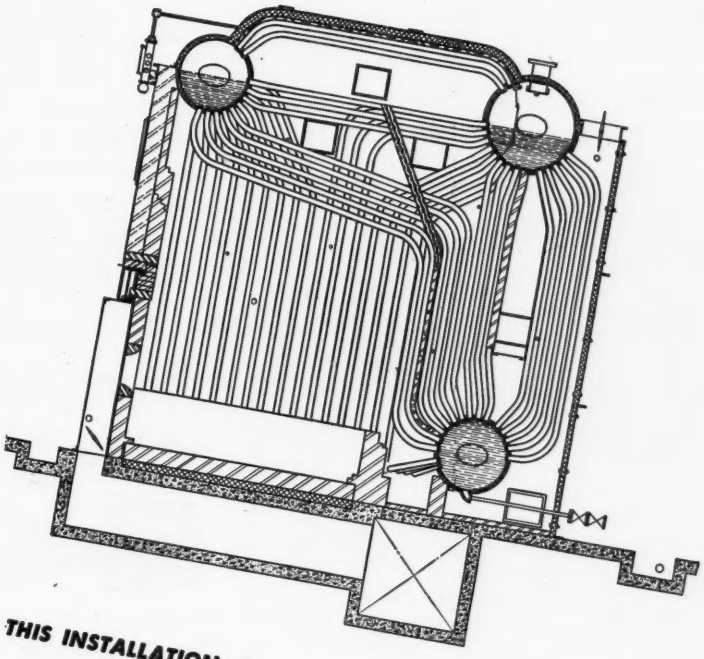

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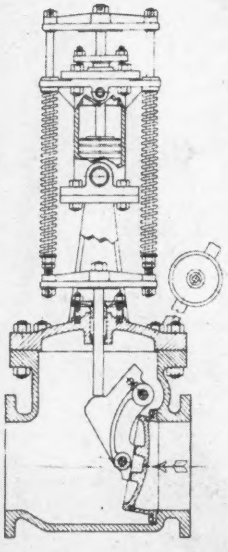

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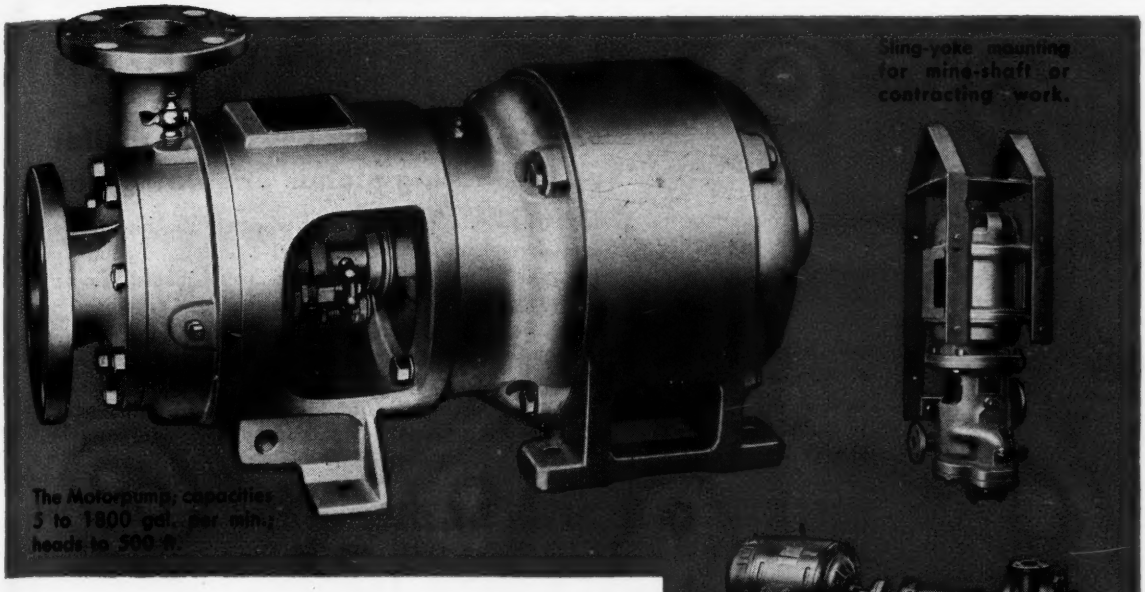

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Sling-yoke mounting for mine-shaft or contracting work.

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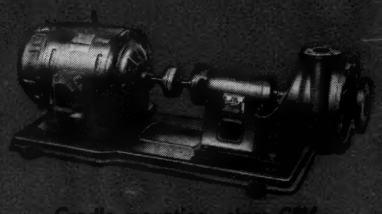
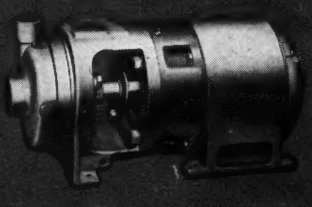


Cradle mounting, class CRY.



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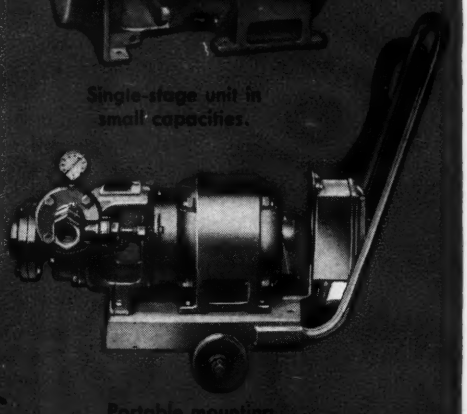
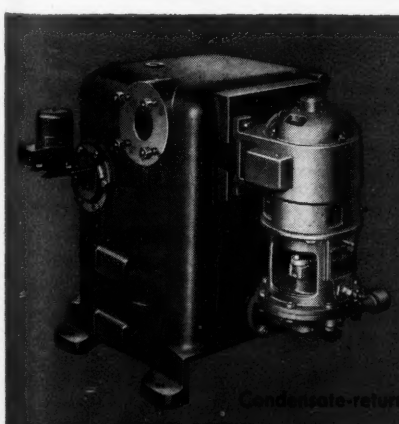


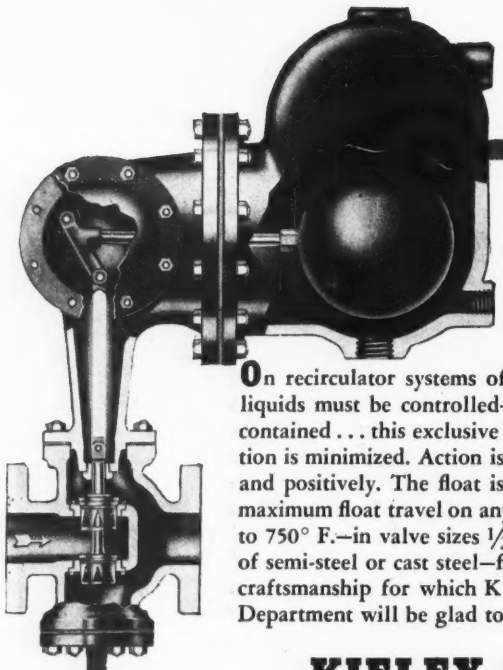
Portable mounting.



Condensate-return unit.

Ask the I-R Service Engineer for Further Details

Close-coupled turbine-driven unit.



NO "GLAND TROUBLE"

because UNITROL Level Controller has no packing glands or stuffing box

On recirculator systems of condenser hotwells, deaerators—or wherever the level of liquids must be controlled—UNITROL will do it more accurately! Simple . . . self-contained . . . this exclusive design eliminates trouble-making restrictive elements. Friction is minimized. Action is free and unhampered. Feed or drain is regulated promptly and positively. The float is linked to the inner valve through ratio connection, with maximum float travel on any size valve of only 7 inches. Available for temperatures up to 750° F.—in valve sizes ½" to 4"—integral casting construction—valve and floatcage of semi-steel or cast steel—float of seamless copper or stainless steel—and with the fine craftsmanship for which K & M has been recognized for 75 years. Our Engineering Department will be glad to make specific recommendations.

Write for General Catalog 66

KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
NORTH BERGEN, NEW JERSEY

Awarded our employees for outstanding production achievement

STOP LEAKS

DAMP PROOF—WATER PROOF

Leaks, water seepage in concrete walls can be stopped instantly—permanently with FLEXTITE. This material will convert wet basements into bone-dry useful space. Will seal leaks against water pressure. Can be used in elevator pits, tunnels, dams, concrete water tanks, retaining walls. Efficient as a plaster coat for waterproofing and dampproofing.

Write for Further Information and Details

FREE TRIAL OFFER

FLEXTITE

FLEXROCK COMPANY
3523-A Filbert St., Philadelphia 4, Pa.
Please send me complete FLEXTITE information . . . . details of FREE TRIAL OFFER—no obligation.
Name .....
Company .....
Address .....

HOW MAGIC BOILER PRESERVATIVE Guards 2 Ways Against Corrosion

Corrosion occurs when oxygen or acid gases act on metal. Oxygen and carbonic acid gas are found dissolved in all natural waters to a varying degree. Hydrochloric acid gas is formed under steaming conditions, when chlorides of iron, magnesium, calcium or sodium are present in feedwater. The liberation of hydrochloric acid gas from these substances is accelerated by the presence of sulfates of calcium and magnesium. Carbonic acid gas is liberated from bicarbonates of calcium and magnesium.

MAGIC Boiler Preservative acts in two ways to guard against corrosion. First, the MAGIC dissolved in the boiler water "binds" acid gases and represses their liberation. Second, the MAGIC film of protection keeps corroding substances from contact with the metal.

Write for Descriptive Bulletin.

GARRATT-CALLAHAN CO.

Established 1904

OF ILLINOIS
59 East Van Buren St.
Chicago 5

OF NEW YORK, Inc.
1328 Broadway
New York City 1

OF CALIFORNIA
148-156 Spear St.
San Francisco 5

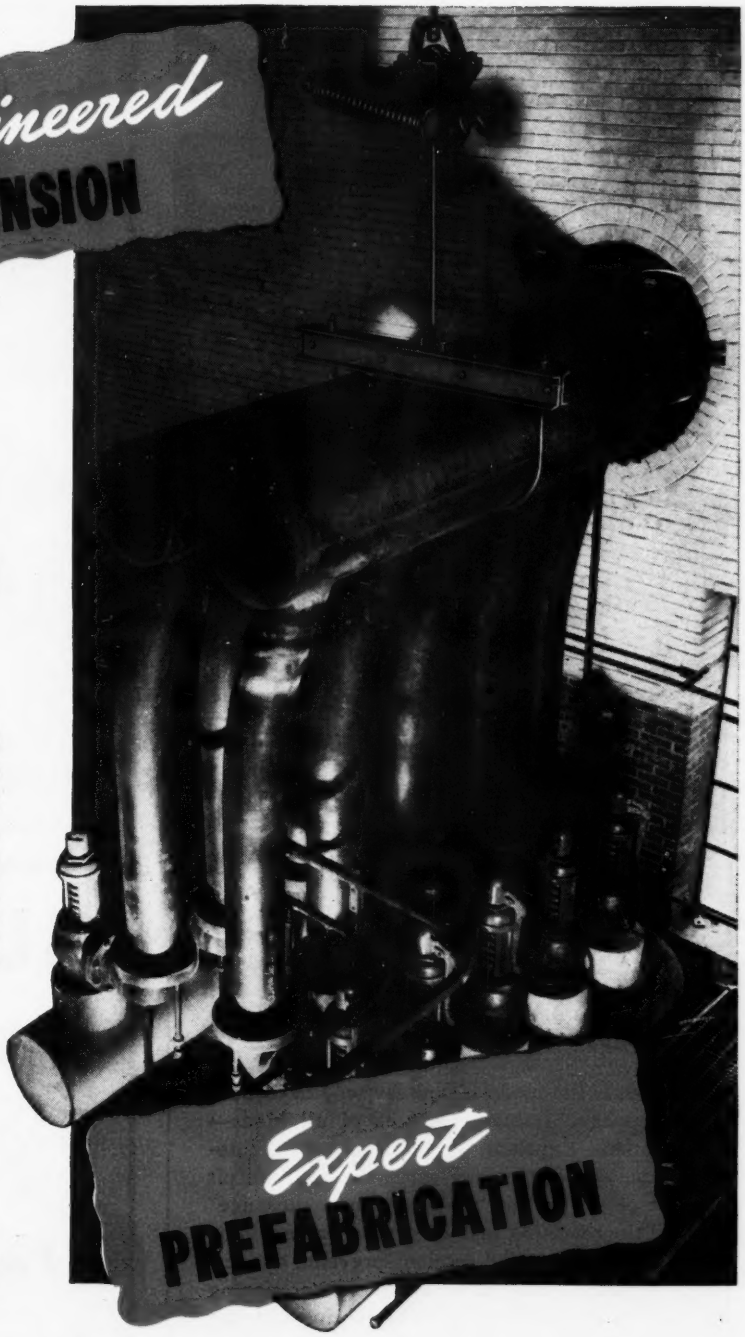
Pre-Engineered SUSPENSION

GRINNELL CONSTANT-SUPPORT HANGERS

The only hanger offering all these important features for high temperature piping support. Constant support of piping in all "hot" and "cold" positions – full safety factor of the supported system is always maintained • Mass produced from standard precision parts • Individually calibrated for each specific installation • Rated capacity of each model varies with the size of the springs used – overall dimensions of the hanger remain constant • Minimum headroom required.

GRINNELL PRE-ENGINEERED SPRING HANGERS

Save engineering time required when hangers are "tailor-made" for each load condition. 14 sizes with a load range from 84 lbs. to 4700 lbs. Minimize changes in pipe supporting force • All-steel welded construction meets pressure piping codes • Unique swivel coupling provides adjustment and eliminates turnbuckle • Compact – require minimum headroom • Installation simplified by integral load scale and travel indicator • Easy selection of proper sizes from Capacity Table.



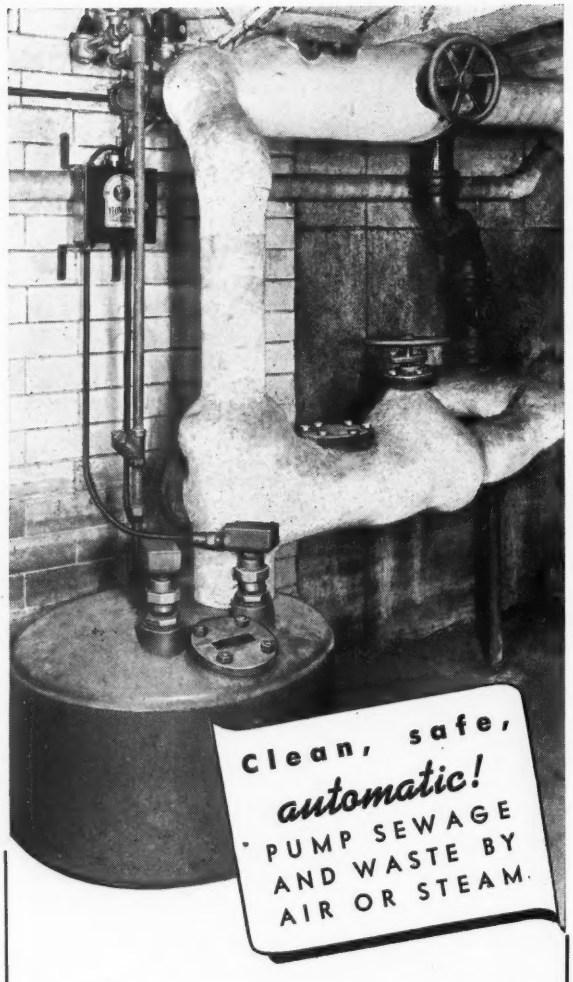
Grinnell also offers expert engineering and prefabrication of pre-tested piping sub-assemblies like this safety valve discharge piping in a power station. Conveniently located Grinnell plants reduce time-consuming field erection. Consult Grinnell Engineers for assistance on any piping installation.

GRINNELL COMPANY, INC.

Executive Offices, Providence 1, R. I. Branch offices in principal cities

GRINNELL

WHEREVER PIPING IS INVOLVED



YEOMANS EXPELSOR

This is the modern sanitary way to dispose of sewage, drainage, wastes of all kinds—Yeomans Expelsor, simple, fool-proof, automatic. It does away with the foul wetpit ejector—ends the "clogged pump nuisance" and the revolting task of pump cleaning. The hermetically sealed receiver prevents dangerous gases. No stuffing boxes, no moving parts to require service and attention—literally, no maintenance. Operates by plant air or steam supply. Capacities from 30 g.p.m. up. Easy, inexpensive to install. Write for bulletin 4402—gives complete information.

YEOMANS BROTHERS COMPANY

1414 NORTH DAYTON ST., CHICAGO 22, ILLINOIS

Please send Bulletin 4402

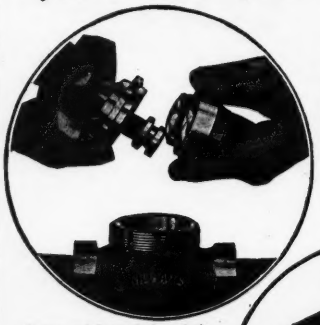
NAME .....

ADDRESS .....

COMPANY .....

Use **VULCODISC**

for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.
Write for descriptive bulletin.

THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

SUPERIOR

AUTO-TITE JOINTS

For Power Plant Use

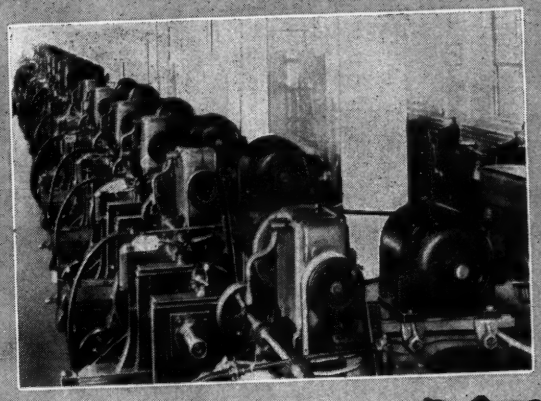
Auto-tite connectors and joints can take rough usage. They assure the free passage of air, steam, water, gasses and liquids, without interruption from impingment, jolting, vibration or frequent changes of direction. Heavy reinforcement at every necessary point assures extra strength and durability.

Types to meet all requirements

Auto-Tite Division of

SUPERIOR RAILWAY PRODUCTS CORP.
7501 Thomas Boulevard, Pittsburgh, Penna.

BEARINGS BEAR UP

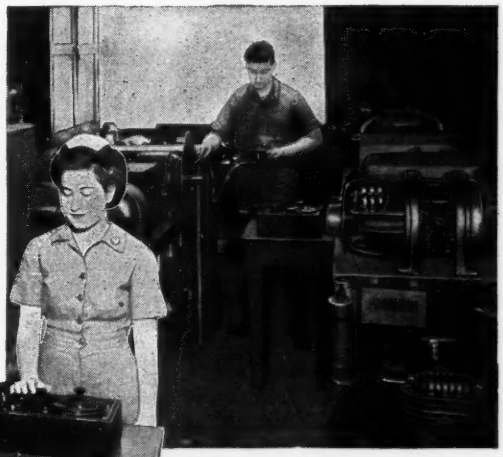


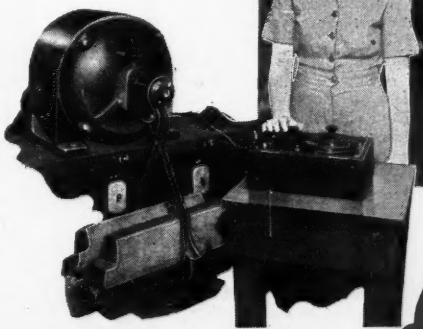
Powered by Tri-Clad sleeve-bearing motors, this battery of milling machines has been in round-the-clock operation on war work since before Pearl Harbor. The short-center, hinge-base drives put a hard, steady pull on the motor bearings. In addition, the machines are in the hands of several different operators each day, many newly trained. Despite the severe service, motor-bearing performance has been above prewar levels. Maintenance manpower has been conserved, and production held on schedule.

Tri-Clad motors driving milling machines in the River Plant Division of the Savage Arms Corp., Chicopee Falls, Massachusetts.

How torture tests on TRI CLAD bearings have helped us lengthen motor life

Before the Tri-Clad motor-bearing designs were adopted, many models of this new motor were tested to destruction under heavy shaft loadings applied from all directions, with various kinds of lubricants, and under many different speed and temperature conditions. As new Tri-Clad types are introduced, these tests continue—some for years—in "torture" areas such as shown at right. Each test broadens our knowledge, offers new clues to longer motor life. Throughout industry, results have substantiated the improved bearing performance forecast by these tests. *General Electric Company, Schenectady 5, New York.*





GENERAL ELECTRIC

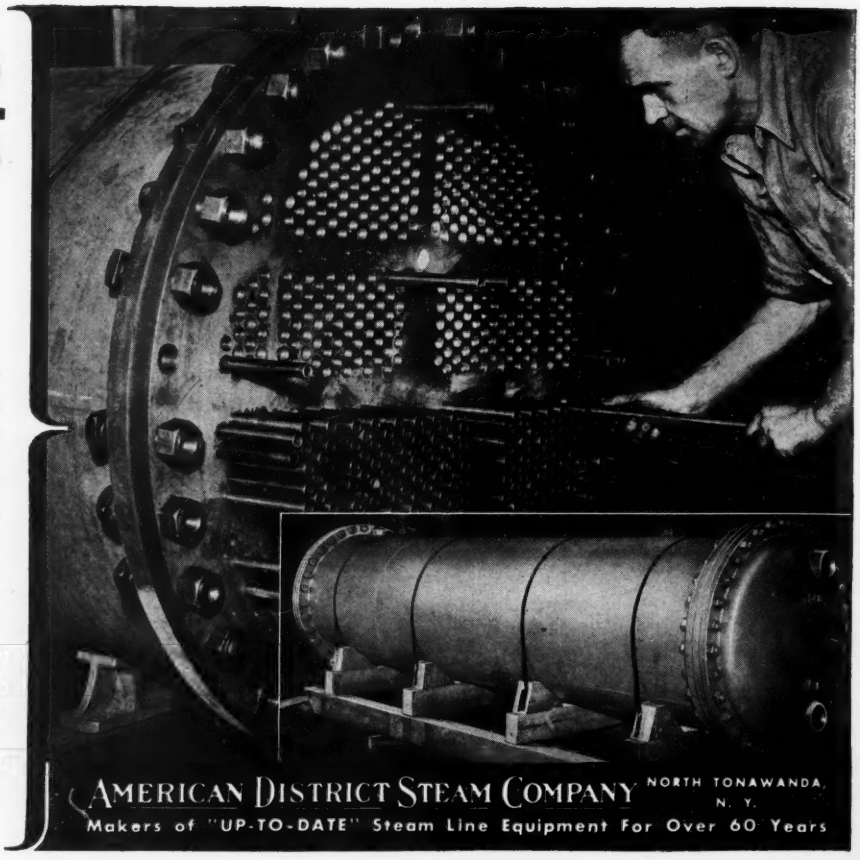
TRI CLAD MOTORS

Buy all the BONDS you can — **AND KEEP ALL YOU BUY**

ADSCO HEATERS are BUILT TO YOUR ORDER

. . . and what is equally important, ADSCO has built heaters for dozens of different applications —can design and build a heater that has the capacity, efficiency and reserve requirements exactly suited to your particular operating conditions.

Whether you require horizontal or vertical, storage or instantaneous equipment to heat or cool water, gases, oil or other liquids, write us or send for bulletin No. 35-75PE.



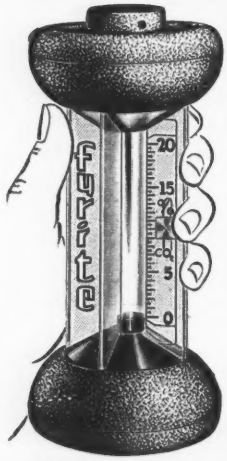
AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.
Makers of "UP-TO-DATE" Steam Line Equipment For Over 60 Years

---

COOPERATE with the NATIONAL FUEL EFFICIENCY PROGRAM **TO SAVE VITAL WAR FUELS**

USE THE **PRACTICAL FYRITE CO_2 INDICATOR**

REVEALS FUEL WASTE *INSTANTLY!*



$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

CO_2 analysis of the flue gases is the only method available for determining the percentage of fuel wasted up the stack. The practical FYRITE CO_2 Indicator makes accurate flue gas tests easy—quickly pointing the way to adjustments and repairs necessary to secure efficient fuel utilization. The FYRITE requires no skill or technical knowledge; is simple and rugged; has no valves, clamps, or leveling bottle, no glass parts or batteries.

OXYGEN INDICATOR designed on same principle available soon. Write for particulars.

RETURN THIS COUPON FOR BULLETIN 341 on FYRITE. *Learn how to get immediate delivery under priority regulations.*

Name _____

Address _____

City _____ State _____ PP

HEATING SERVICE DIVISION
BACHARACH
Industrial Instrument Co.
7000 BENNETT ST.
PITTSBURGH 8, PA.

HAVE YOUR BOILERS EQUIPPED WITH "SPLIT-GLAND TYPE" INCLINED *Water Gages*

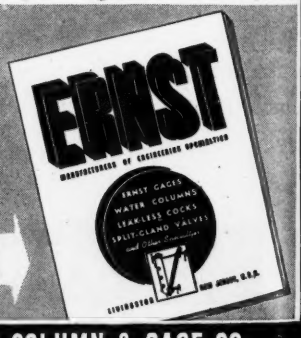
← An unobstructed and clear view of the water level

NO Gage Glass Packing Nuts

TO HELP YOU KEEP BOILERS SAFE . . .

FREE

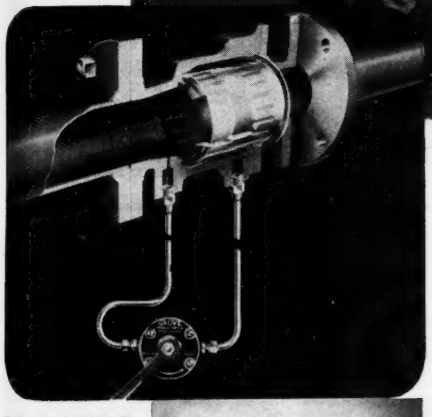
BOILER SPECIALTY CATALOG No. 45



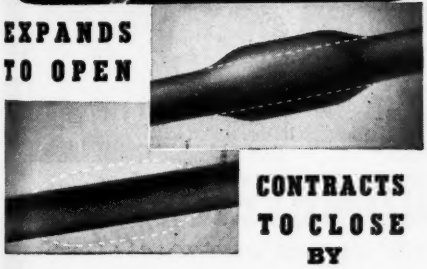
ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, NEW JERSEY

GROVE *Flexflo Remote Control* VALVES

HANDLE HIGHLY CORROSIVE AND EROSIVE LIQUIDS & GASES



EXPANDS TO OPEN



CONTRACTS TO CLOSE BY *Remote Control*

EMPLOY JUST ONE NON-METALLIC MOVING PART TO OPEN OR CLOSE

The fully self-contained, self-operating Grove Fexflo Remote Control Valve is automatically self-compensating for abrasive wear resulting from the transmission of fluids containing sand or other small solid particles. It is designed for any fluid service such as handling oil, water, salt water, chemical solutions, gases and air. Its flexible expansible tube overcomes not only the problems of erosion but also that of corrosion and electrolytic action, commonly encountered in ordinary valves. The Grove Flexflo establishes a new low in valve maintenance. Adjustments or servicing are seldom if ever required. Just one non-metallic moving part operates to open and close the valve. The tube and core, after extended periods of constant and severe service, can be quickly replaced. No machining, grinding, lapping or other operations are necessary. Exhaustive "LIFE TESTS" disclose that after opening and closing more than 250,000 times, the Flexflo Valve shows no perceptible wear. Positive bubble-tight, air-tight shutoff at maximum working pressure—as well as smooth non-turbulent streamline flow is definitely assured at all times.

Write for full details today. Ask for bulletin 800.

GROVE *Flexflo* REMOTE CONTROL VALVES

GROVE
SIMPLICITY
ACCURACY
SAFETY

GROVE REGULATOR COMPANY
6547 GREEN STREET, OAKLAND 8, CALIFORNIA. Branch Offices: 3 Rockefeller Plaza, New York 20 • 5644 Navigation Boulevard, Houston 11, Texas • 1930 West Olympic Boulevard, Los Angeles 6, California

WRITE TODAY FOR BULLETIN 800

TAKE THIS SIGN OUT OF YOUR FACTORY PERMANENTLY WITH

STONHARD RESURFACER

RUTS AND HOLES BANISHED OVERNIGHT

By Your Own Handyman *with* A Drum of Stonhard Resurfacer

100,000 Satisfied Customers

30 Maintenance Products

STONHARD COMPANY

ESTABLISHED IN 1922

811 Terminal Commerce Bldg., Philadelphia 8, Pa.

Sales Offices and Stocks in Principal Cities

AC-ME GAS GRAVITOMETER

Recording Type

For accurately recording the specific gravity of gas.
Contains no complicated rotating parts.
Automatically compensated for atmospheric temperature and barometric pressure variations.
Rugged construction requiring a minimum of maintenance.

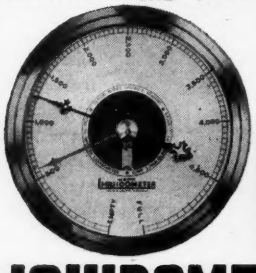
Write for Bulletin

LABORATORY APPARATUS
SCIENTIFIC INSTRUMENTS
POWER PLANT EQUIPMENT

THE REFINERY SUPPLY CO.

Main Office and Plant
621 E. 4th St. • TULSA 3, OKLA. • Ph. 4-3148, L.D. 581
Branch Office:
1309 Capitol Ave. Houston 2, Texas Ph. Fairfax 5814

THOSE WHO CAN'T AFFORD TO MAKE ERRORS IN MEASURING VALUABLE STORED LIQUIDS CHOOSE—



LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic.

No pumps, valves, or auxiliary units needed to read them.

Models available for either remote or direct readings.

Accuracy unaffected by specific gravity of tank liquid.

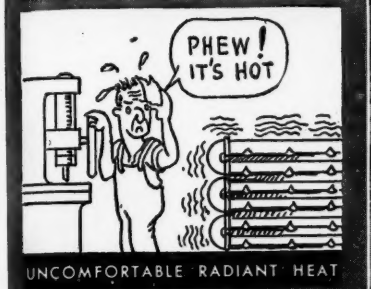
Approved by Underwriters' Laboratories for gauging hazardous liquids.

Write for complete details.

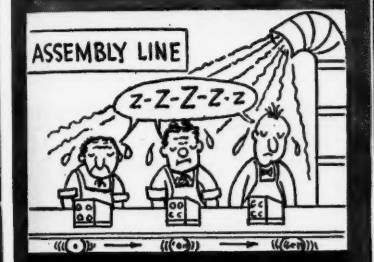
THE LIQUIDOMETER CORP.

36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

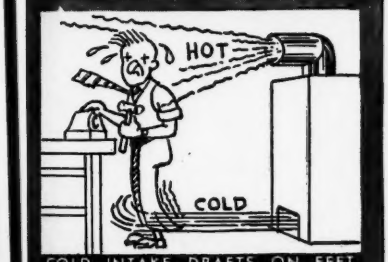
HEAT DOES NOT REACH WORKING ZONE



UNCOMFORTABLE RADIANT HEAT



SICKENING BLASTS OF HOT AIR

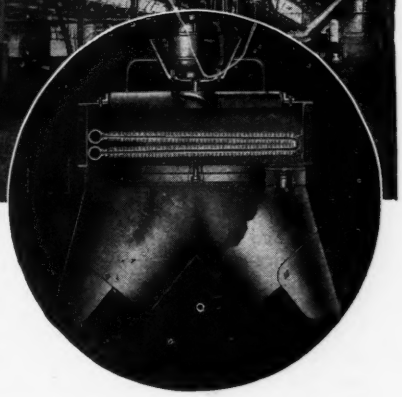


COLD INTAKE DRAFTS ON FEET
HOT DRAFTS ON THE HEAD

SOME WORKERS TOO HOT WHILE OTHERS ARE TOO COLD

Were YOU annoyed by heating complaints last Winter?

(Above) Installation of 63 Wing Revolving Unit Heaters in Plant of Automotive Appliance Manufacturer



Cross-sectional view of WING Revolving Unit Heater, showing Motor, Fan, Heating Element and Revolving Discharge Outlets.

The objectionable features of heating systems like those cartooned at the left are the cause of endless complaints.

WING *Revolving* HEATERS

ELIMINATE HOT SPOTS AND COLD SPOTS

Located at roof or ceiling, they revolve slowly, projecting the heated air to the working level in moving streams which sweep slowly through 360 degrees, covering successively every direction instead of constantly in some one direction. The gentle air motion and the thorough coverage bring a sensation of fresh, live, invigorating warmth to workers. **And in the Summer, with the steam turned off, they create a delightful cooling effect that is equally effective in stimulating production.**

Write for Bulletin HR-3

L. J. Wing Mfg. Co., 64 Seventh Ave., New York 11, N. Y.

Factories: Newark, N. J. Montreal, Canada

2 IMPORTANT ADVANTAGES

. . . in this DUPLEX BOILER BLOW-OFF UNIT

1. Tightness

. . . is assured and maintained by the self-grinding seal of the Everlasting Blow-off Valve and the narrow, flexible sealing ring of the Everlasting Companion Angle Valve. In the Everlasting Blow-off Valve, the disc moves across the seat in *rotating motion* and is in *constant contact* with the seat, thus regrinding the disc against the seat whenever the valve is opened or closed. In the Everlasting Companion Angle Valve, a perfectly fluid-tight seal is provided by the flexible narrow-face ring which yields to slight irregularities of the sealing surface and the sealing edge as it is compressed between them.

2. Resistance to wear

. . . is provided by the constant spring-maintained contact of disc and sealing surface which prevents grit from getting between the sealing faces of the Everlasting Blow-off Valve disc and seat; and by the design of the Everlasting Companion Angle Valve in which the sealing elements are not subject to destructive erosion from the flow of fluids.

Made in sizes 1½-in., 2-in., and 2½-in. for 250-lb., 300-lb. and 600-lb. Comply with all code requirements.

EVERLASTING VALVE COMPANY

49 Fisk Street, Jersey City 5, N. J.

Everlasting Valves

for everlasting protection

For Safe, Accurate Pressure Control—

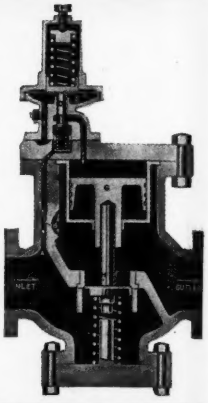
Golden-Anderson

STEAM PRESSURE REDUCING VALVES

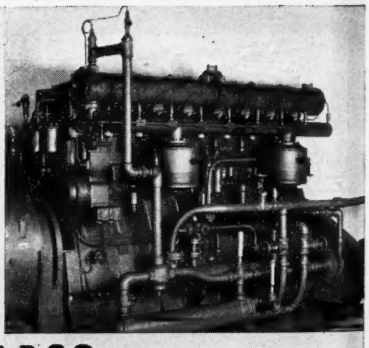
★ Will positively hold any adjusted delivery pressure "right on the nose" at all times. Particularly adapted for intermittent or dead end service.

Pilot control may be located remotely from main valve. Efficiently handles 125 lb. to 400 lb. saturated or superheated steam.

This and other specialty valves are described fully in new G-A Catalog. Write today for your copy.



GOLDEN-ANDERSON
VALVE SPECIALTY CO.
FULTON BUILDING, PITTSBURGH, PA.



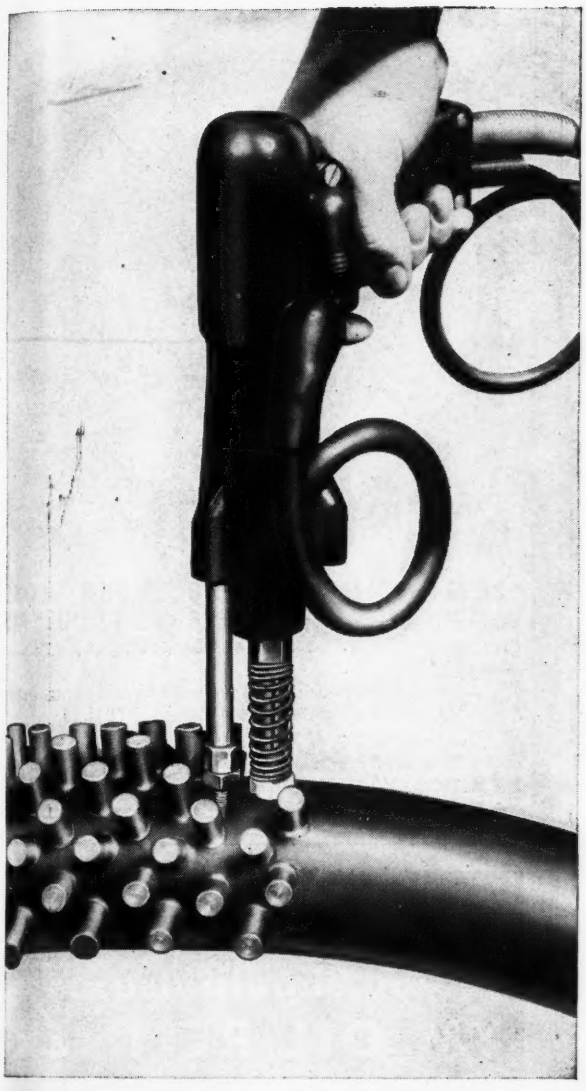
SARCO

Water Blenders

This is the low cost mixing valve that is saving tons of water and fuel in a dozen ways. Used on cooling jackets it increases engine and compressor efficiencies. It saves heat and water on gang showers and in apartments. It provides simple temperature control of brine cooling systems by regulating recirculation. Three types — ask for Catalogs Nos. 700 and 800.

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York 17, N. Y.
SARCO CANADA, LTD., 85 Richmond St. W., TORONTO, ONT.



How to repair burned-out boiler tubes!

The Nelson Stud Welder will make your boiler maintenance and repair easy. Why keep a large inventory of studded pipe on hand? Or, why keep your boiler out of operation for a long period when you can repair it at your own plant?

The photographs illustrate the ease of application and the consistent welds achieved. One operator and a helper can average about 2300 studs or about 24 feet of tube, in eight hours.

The Nelson Stud Welder is *completely portable* and light in weight. Proven by five years of actual use and employed by more than 300 industrial plants, it can be used for repair and maintenance wherever there is need to end-weld studs to metal.

Write today for complete details and catalog. Find out exactly how you will save up to 75% of your time and material cost. Write to:

NELSON SPECIALTY WELDING EQUIPMENT CORP.

Dept. P-6, 440 Peralta Avenue, San Leandro, Calif.

Eastern Representative: Camden Stud Welding Corp. Dept. 122, 1416 South Sixth St., Camden, N. J.

Studs are welded 1¼" apart on 19° centers. Nelson studs are manufactured in numerous diameters and lengths. The studs are simply placed in the chuck of the gun, a ferrule placed on, and the trigger pulled. An arc is created which *automatically* welds the stud to the tube.

Complete fusion between the stud and tube results from automatic timing and complete shielding of the arc. The strength of the weld is equal to the strength of the stud. *No previous welding experience is necessary to operate the Nelson gun.*

MITCHELL *Fabricated* PIPING

WITH THE LATEST IN

POWER PIPING DESIGN

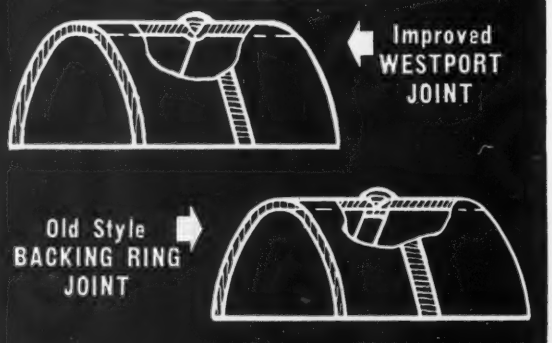
including the New

WESTPORT WELDED JOINT

FOR ALL PRESSURES AND TEMPERATURES

Complete penetration with smooth, sound welds providing streamline interior contour and *without* the use of Backing Rings which may obstruct flow or sacrifice pipe wall strength with unnecessary machining. Write for bulletin describing in detail advantages of Westport Welded Joint.

1899 1944



W. K. MITCHELL & CO., Inc.

PHILADELPHIA 46, PENNA.

Fabricators and Erectors
Specialists in Alloy Piping

USE MERCOID "DA" CONTROLS FOR THOSE TEMPERATURE AND PRESSURE PROBLEMS

Both controls are available in a number of ranges for various conditions involved.

The features pointed out in the above illustration have made these controls favorites among leading engineers.

Mercoid Catalog No. 600 contains full information on the entire line of Mercoid Controls and Mercury Switches.

THE MERCOID CORPORATION, 4229 W. BELMONT AVE., CHICAGO 41, ILL.

Why

you should use a

YM OIL REFINER

★ Widely used YM process now *continuous and automatic.*

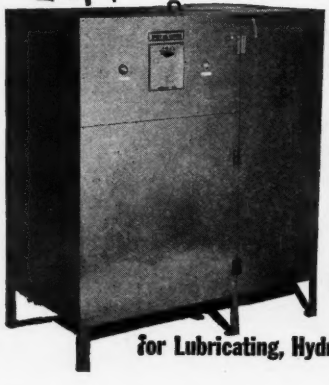
★ For lubricating oil including aircraft engine oil — YM removes fuel dilution, water, acids, carbon, dirt and similar matter from dirty oil.

★ Restores used oils to the same viscosity, fire and flash, neutralization number, precipitation number, emulsion test, color, etc., as the new parent oil.

★ Reclaimed oil can be reused in the same manner and place as the new parent oil.

★ The same machine can handle different kinds and different grades of oil without adjustment.

Send for proposal concerning your requirements.



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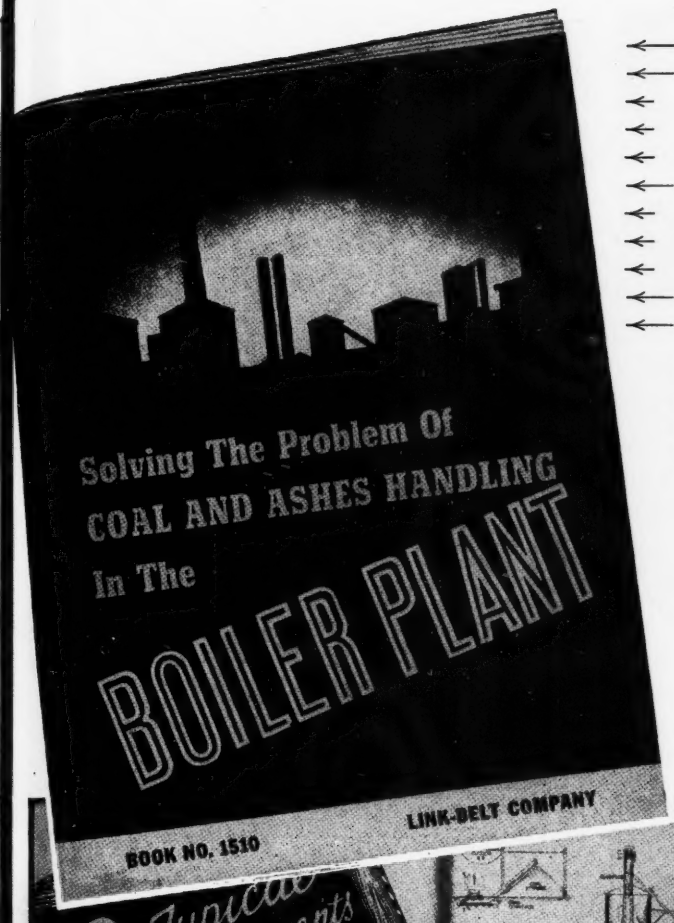

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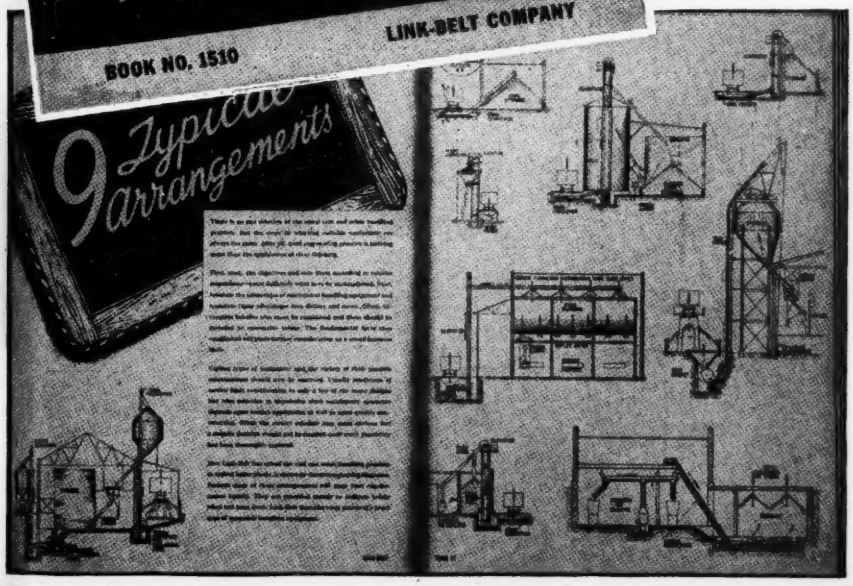

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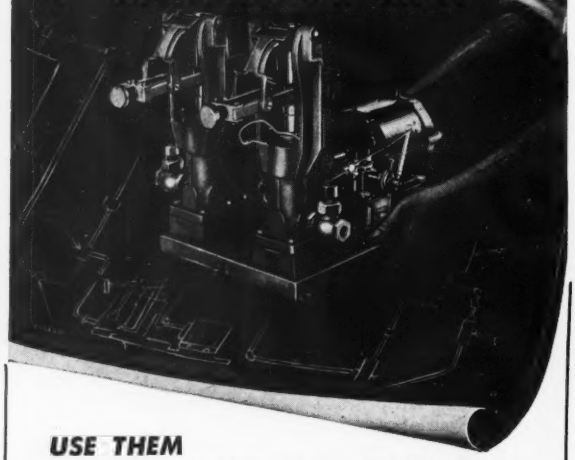

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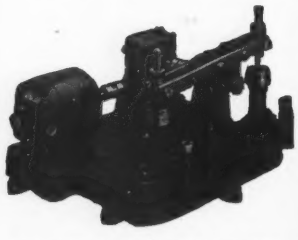

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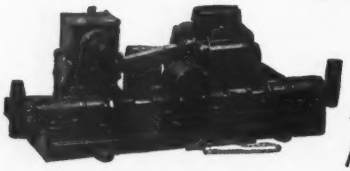

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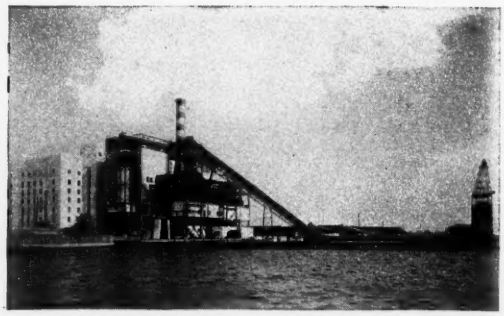

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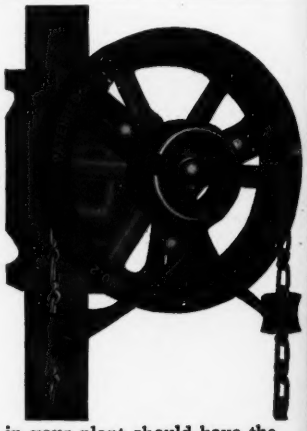

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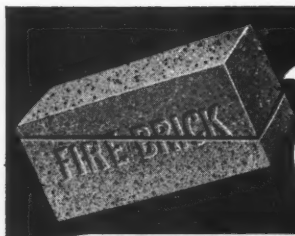

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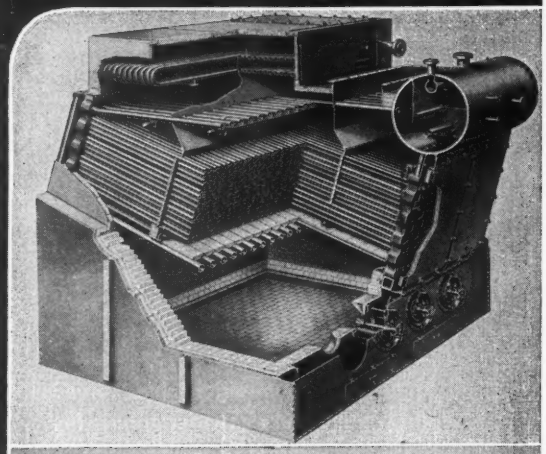

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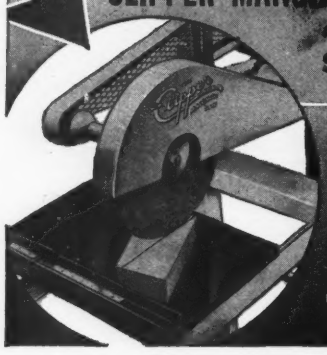

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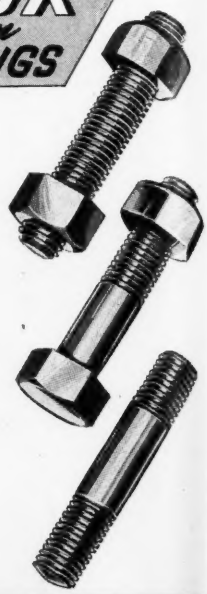

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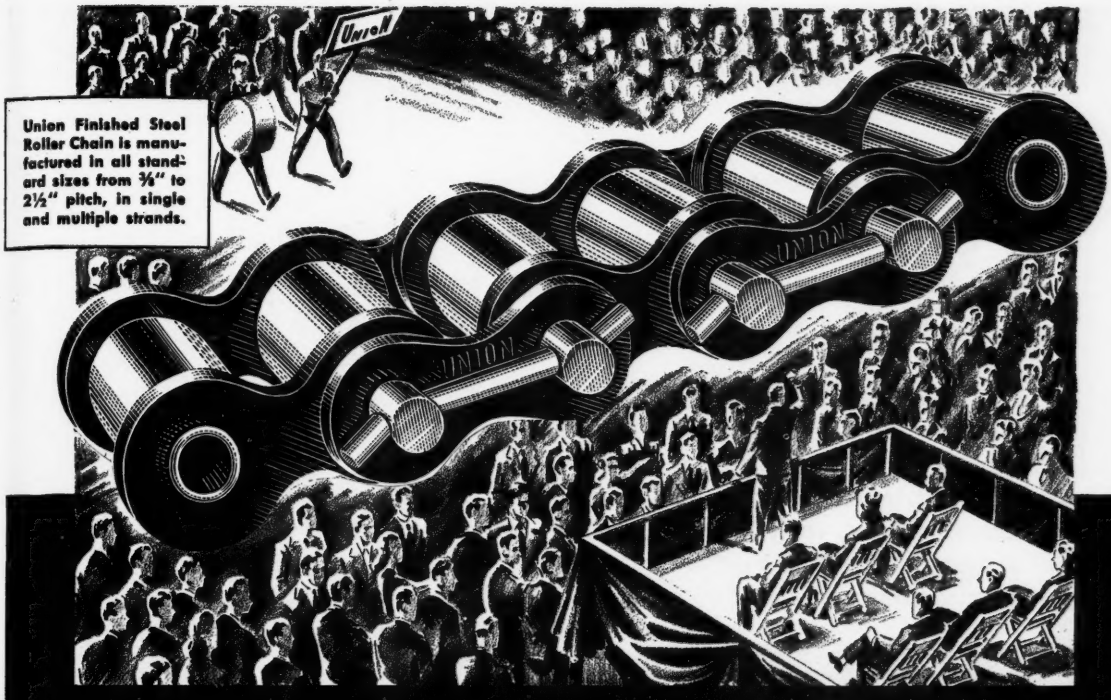

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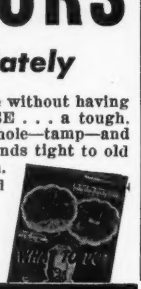

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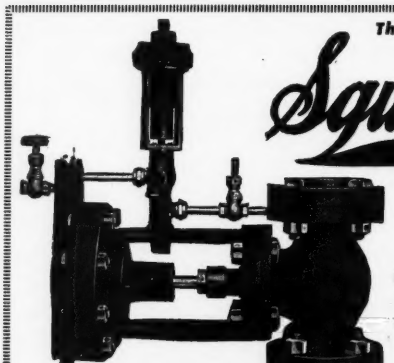

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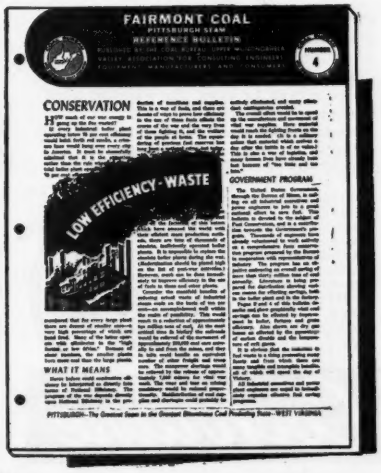
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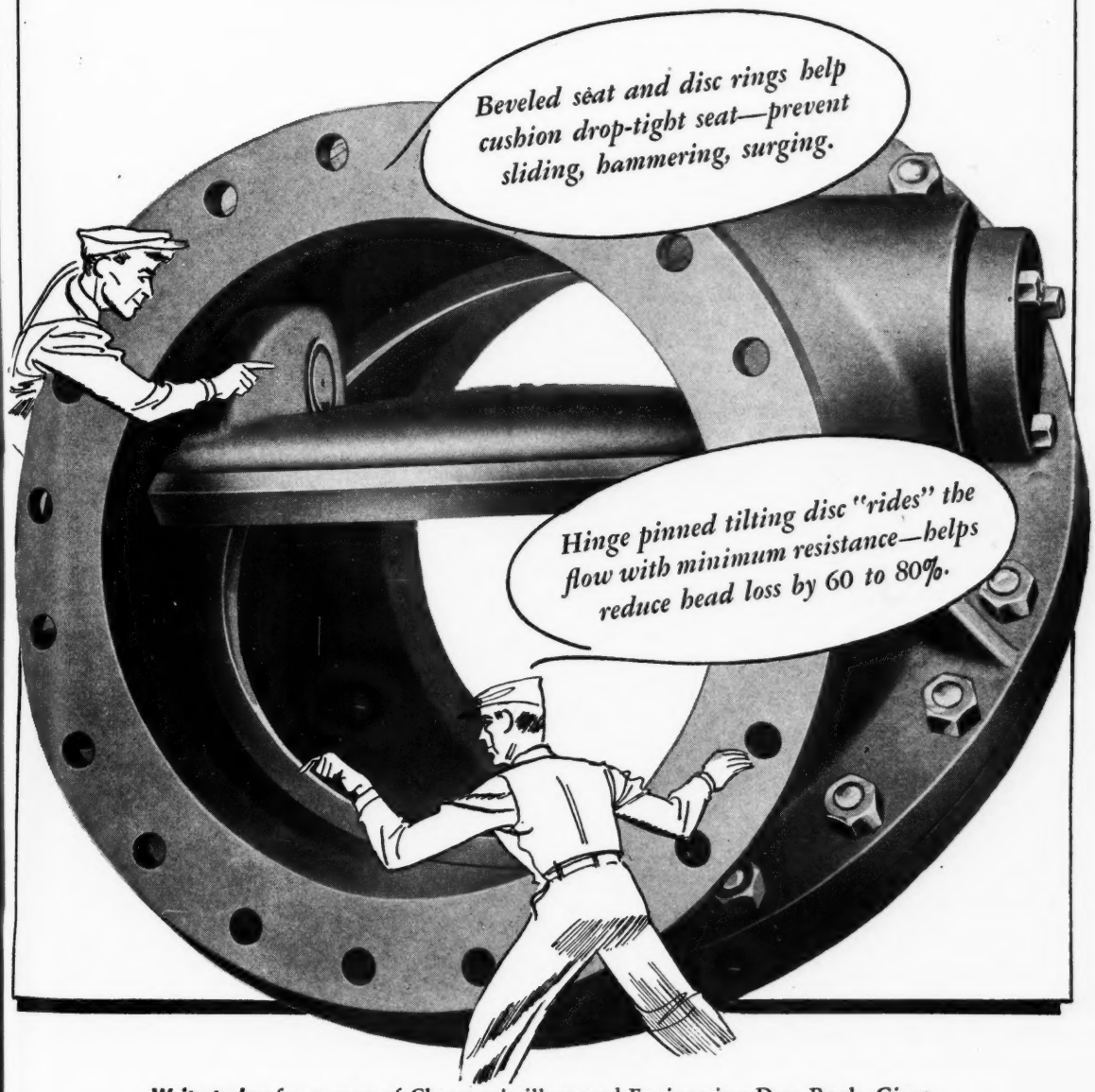
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